AeroCom posters

Beijing 2016

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- STANELLE
- STANELLE

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- YANG
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AFFUM

Transport and Fate of Refinery Particulates within a Coastal/Industrial Area in Ghana

H.A. Affum[1], V. Armenio[2], J.J.Niemela[3]

[1]National Nuclear Research Institute, Ghana Atomic Energy Commission, Accra, Ghana

[2]Dipartimento di Ingegneria e Architettura, Universita di Trieste, Trieste, Italia

[3]Applied Physics Section, The Abdus Salam International Centre For Theoretical Physics, Trieste, Italy

Introduction

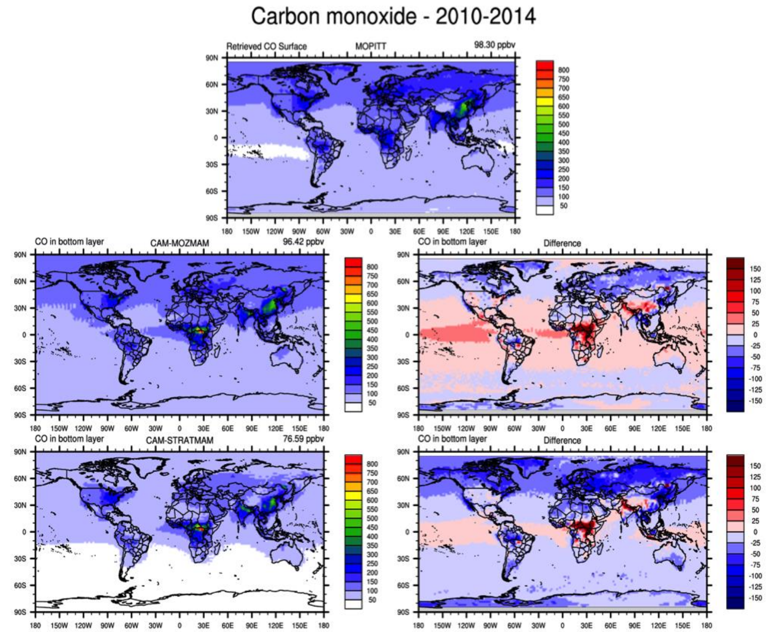
- This article deals with the simulation of the **transport and fate of particulates** from the Tema Oil refinery **in Tema, Ghana**.
- The **California Puff** (CALPUFF) **Modelling**, comprising the dispersion model CALPUFF, the meteorological model CALMET and its postprocessing component CALPOST, was used.
- CALMET was initialised with Weather Research and Forecasting (WRF) data to develop the **meteorological field** for CALPUFF.
- Other inputs into CALPUFF include **terrain, landuse/land cover data, emission rates** from the refineries flare and flue stacks as well as point source characteristics.
- **Average concentrations** at identified receptors within the 60 km^2 study area **were predicted**.

ALVIM

Evaluation of CAM-chem simulations with CO and aerosol satellite data and investigation of Fire Radiative Power with CO and AOD observations

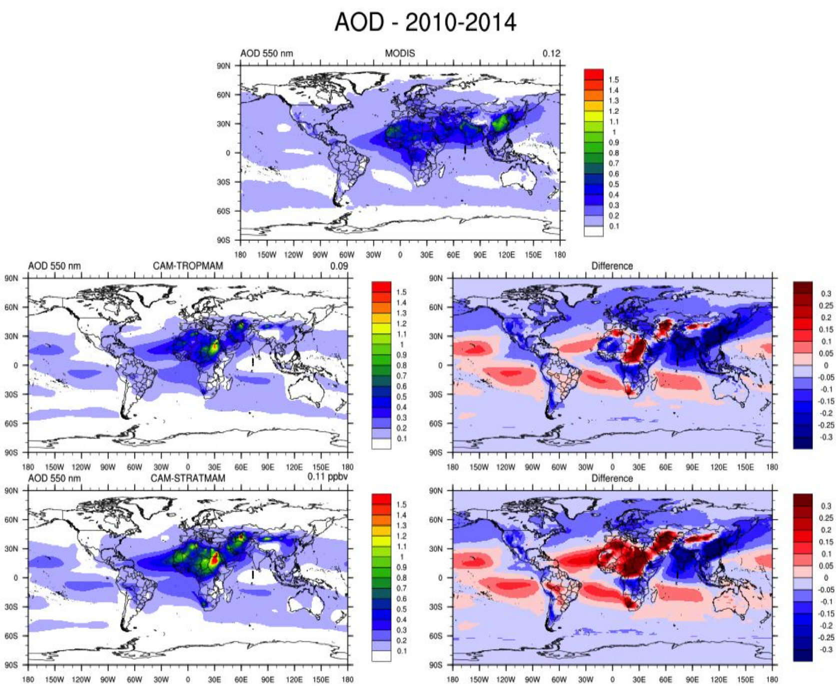
[1]Center for Weather Forecasting and Climate Studies - National Institute for Space Research, Cachoeira Paulista, SP, Brazil
[2]Rio de Janeiro State University, Faculty of Technology, Resende, RJ, Brazil
[3]Department of Geography, University of Sao Paulo, São Paulo, SP, Brazil

Main results



for CO:

inclusion of stratospheric chemistry → decrease +ve bias



for AOD:

overestimation over deserts

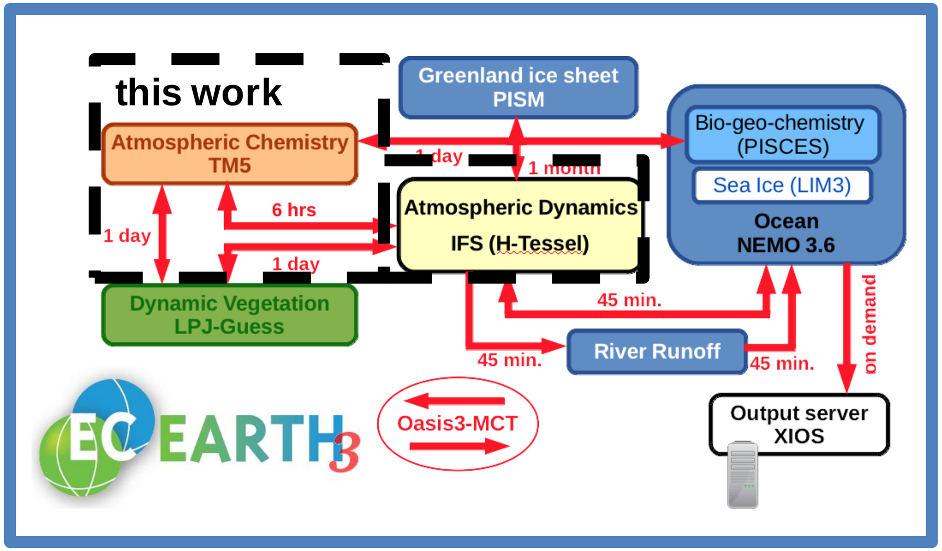
underestimation over regions associated with anthropogenic activities

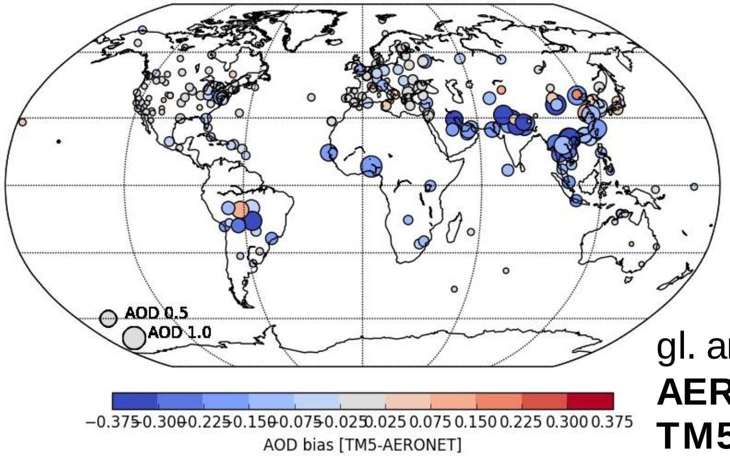
BERGMAN

Validation of aerosol optical properties of EC-Earth and stand-alone TM5

Tommi Bergman,
Twan van Noije, Philippe Le Sager

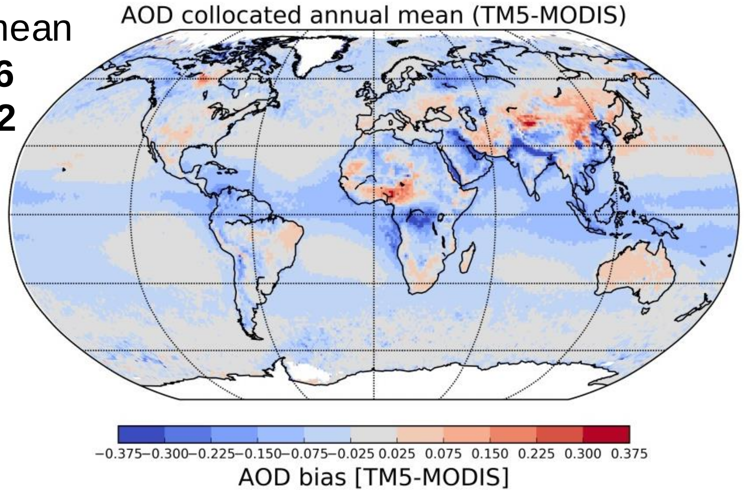
- Preparing for AerChemMIP
- Evaluation of TM5 in EC-Earth to ensure performance
- Off-line and EC-Earth versions compared
- Collocation of MODIS, AERONET and TM5





gl. annual mean
AERONET 0.17
TM5 0.15

gl. annual mean
MODIS 0.16
TM5 0.12

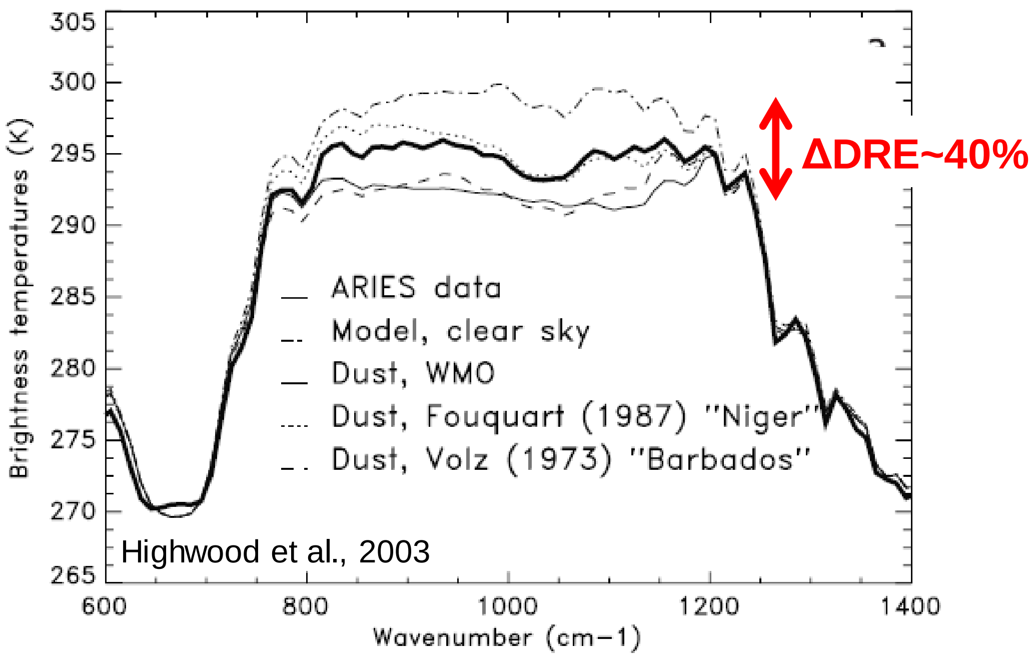


di BIAGIO

Global scale variability of the mineral dust LW refractive index: a new dataset for climate modelling and remote sensing

Motivation

Strong sensitivity of dust LW DRE to refractive index



Di Biagio et al., POSTER P-1-03

Di Biagio et al. submitted to ACPD

RedDUST project

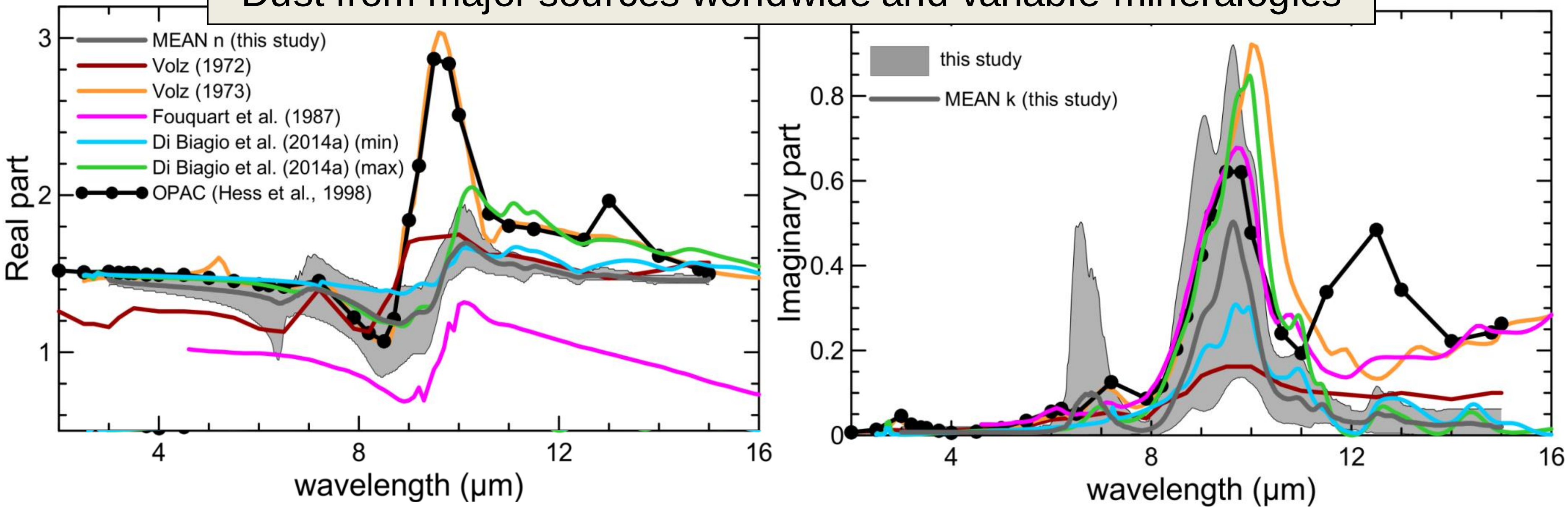
Laboratory experiments in CESAM chamber

Optical inversion

Complex refractive index (2-16 μm)

A unique dataset for climate modelling & satellite retrievals!!

Dust from major sources worldwide and variable mineralogies



The dust LW refractive index strongly varies with the particle origin

→ different values have to be used for different sources

The dust LW refractive index does not modify due to the loss of coarse particles

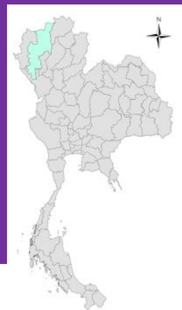
→ the same value can be used at emission and during short-to-medium range transport

Di Biagio et al., POSTER P-1-03

Di Biagio et al. submitted to ACPD

CHANTARA

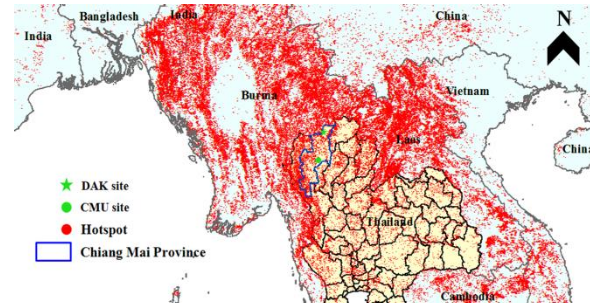
Chemical composition of $PM_{2.5}$ from near source and urban sites in Chiang Mai, Thailand during biomass burning season

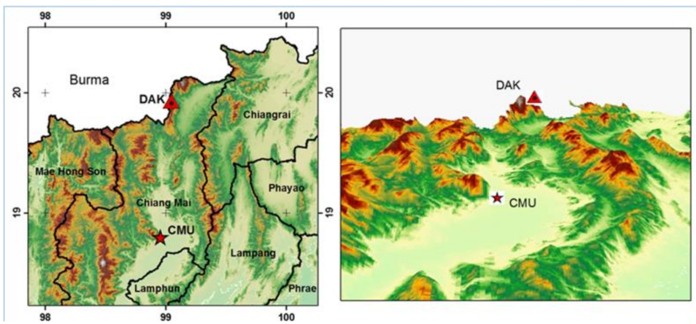


Somporn Chantara*, Chanakarn Khamkaew and Wan Wiriya
Chemistry Department and Environmental Science Program,
Faculty of Science, Chiang Mai University, Thailand
*somporn.chantara@cmu.ac.th

Objectives:

- To find signature chemical profiles from the near-source BB aerosol, in Northern Southeast Asia.
- To identify different source regions contributing to the biomass burning (BB) aerosol samples by 3-days backward-trajectory analysis (HYSPLIT model).

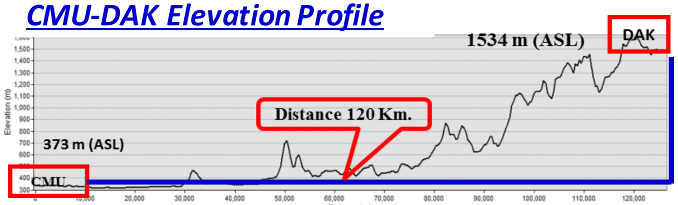




Sampling stations :

- Doi Ang Khang (DAK) (near source)
- Chiang Mai University (CMU) (urban site)

CMU-DAK Elevation Profile

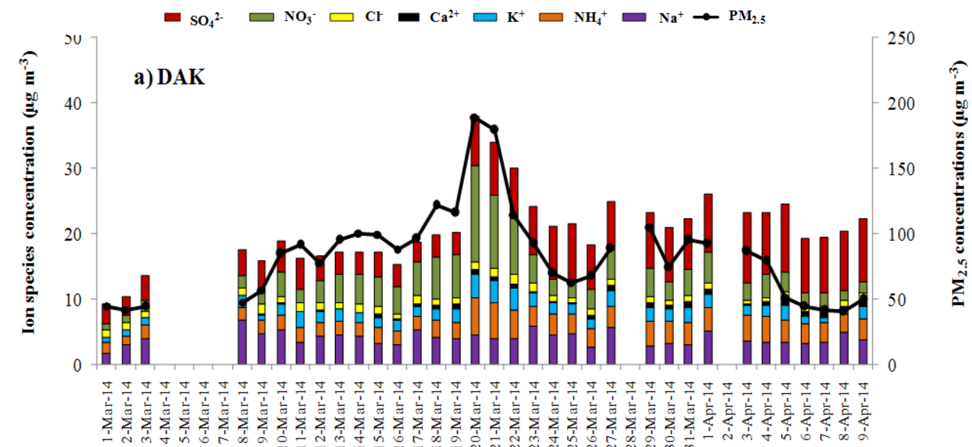


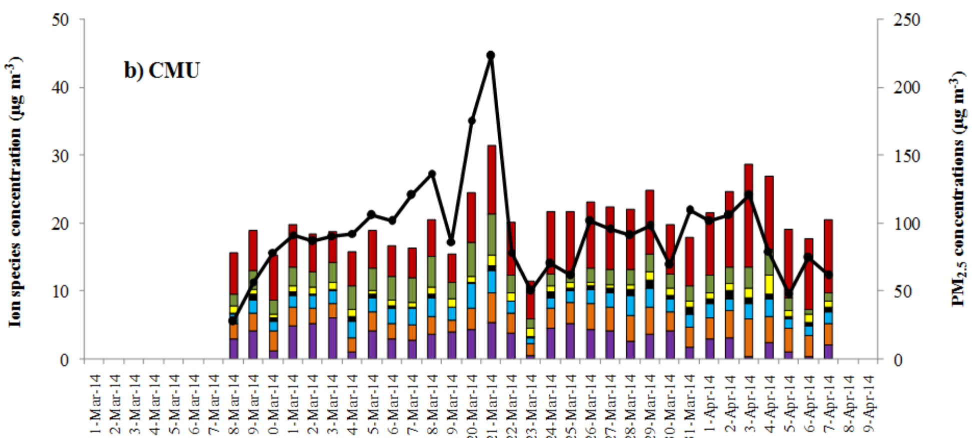
Sample collection :

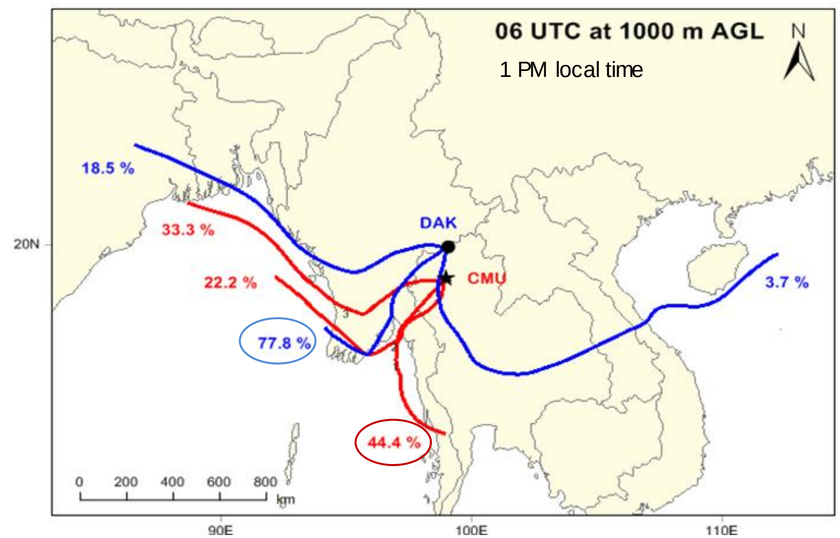
- Collect 24-hrs $PM_{2.5}$ samples (daily basis) on quartz fiber filter (Ø 47 mm) by using mini volume air samplers (5 L/min)
- Duration: 1 March – 9 April 2014

Results PM$_{2.5}$ concentrations: …. at CMU (92.5 ± 32.7 µg m^{-3}) … at DAK (82.0 ± 33.8 µg m^{-3})

- The average PM$_{2.5}$ concentrations were well correlated ($r = 0.8$)
- The major ions at both sampling sites were SO_4^{2-} (30–38% of total ions), NO_3^- (13–20%) and Na^+ (16–20%).
- Moderate correlations (r = 0.5 – 0.7) between levoglucosan and K^+ at both sites were influenced by biomass burning.







Conclusions

- PM$_{2.5}$ concentrations of near- and far- BB source locations were well correlated.
- Biomass burning was a major source of ambient PM$_{2.5}$ during smoke haze episode.
- At the urban site (CMU), mix sources of BB and traffic emission are observed by Principal Component Analysis (PCA).
- Major air masses approaching to both sampling sites came from southwest direction.

DU

Modeling investigation of rapid formation of a regional winter haze covering a mega-city cluster in North China Plain

Jie Li, **Huiyun Du**

LAPC, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

- An extremely severe haze hit Beijing-Tianjin-Hebei (BTH) area from 26 November to 2 December 2015, with hourly $PM_{2.5}$ maximum exceeding 1000 μg/m^3. And Beijing released the first orange alert this year.
- The Nested Air Quality Prediction Model System (NAQPMS) with an on-line tracer-tagged module was used to investigate the haze episode.

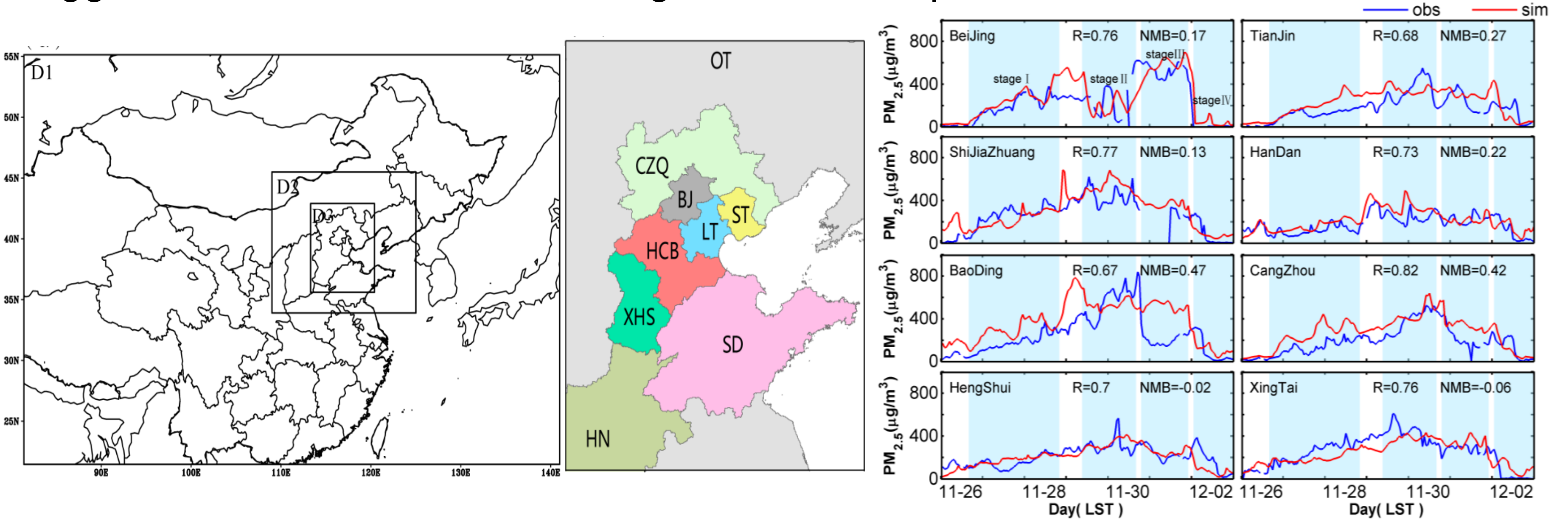


Fig.1 Model domain; Regional separations for on-line tracer-tagged module (capital characters); Comparison between observed (blue) and simulated (red) hourly concentrations of $PM_{2.5}$ for different cites in BTH area. Stage I, II, III, IV are the defined four stages in this study.

- Pollution episode was divided into four stages for all sites. At the ground level, only $PM_{2.5}$ of Beijing experienced an explosive growth (increased to 626 μg/m³ within 5 hours) mainly due to regional transport (~60%).

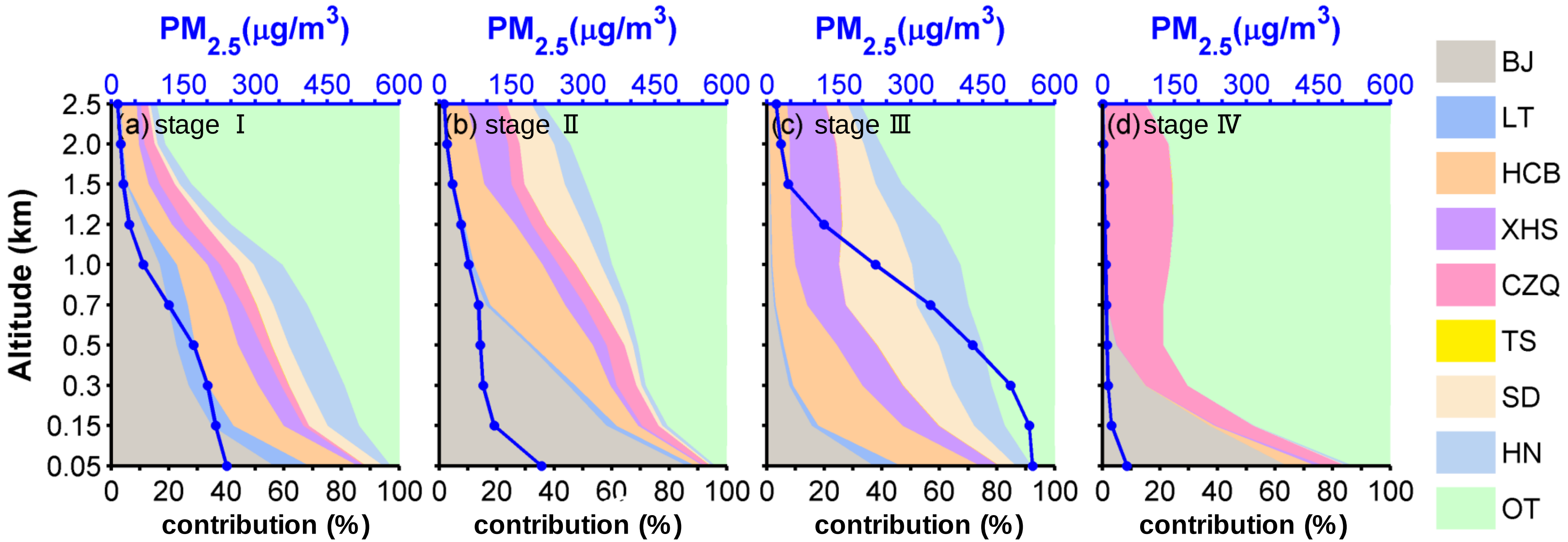


Fig.2 Vertical profile of contributions from various source regions to $PM_{2.5}$ in Beijing in four stages(a-d), and blue line refers to average concentration of $PM_{2.5}$ in each stage.

- As altitude increased, local impact decreased significantly while regional transport influence increased.
- In the rapid growth stage, regional transport dominated $PM_{2.5}$ from surface to 1500 m, with magnitudes from 60-100%, resulting from southerly air mass. And joint-control measures should be taken over surrounding provinces.

FENG

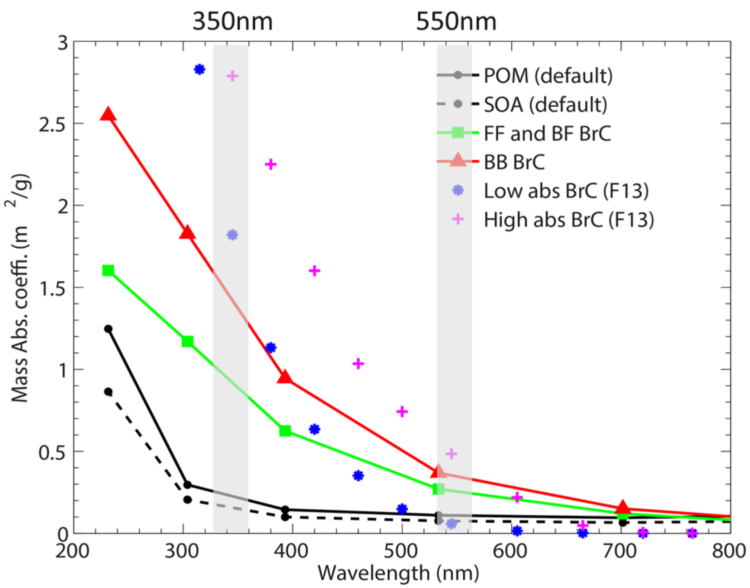
Increased Absorption by Brown Carbon
Impact on Black Carbon Radiative Effect

Yan Feng[1], Xiaohong Liu[2], Rao Kotamarthi[1], Zifeng Lu[1] and David Streets[1]; [1]Argonne National Laboratory, [2]Univeristy of Wyoming

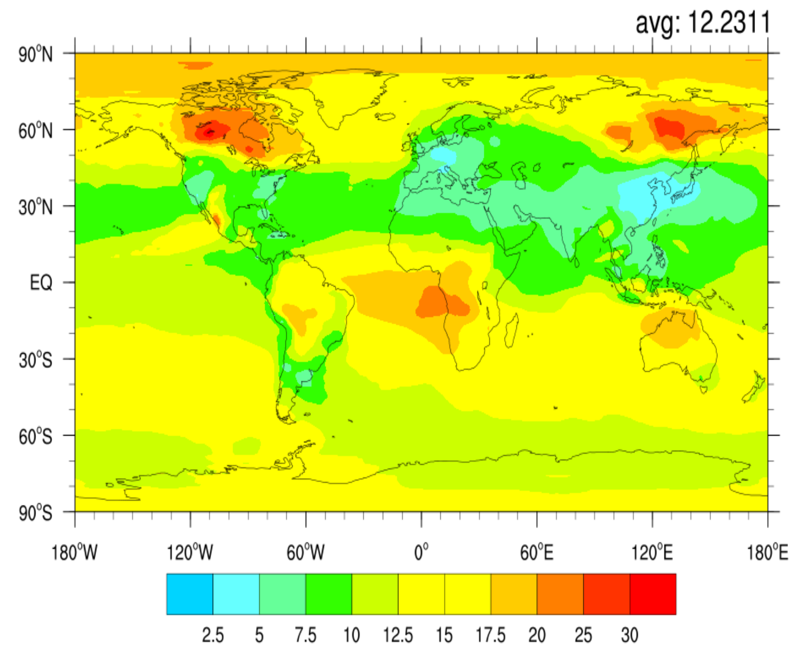
Question: brown carbon (BrC) increases aerosol absorption by about 10-20% globally; how does this increased atmospheric heating affect black carbon (BC) and its radiative effect in climate models?

Methodology: we developed a source-dependent parameterization to account for light absorption due to primary BrC and implemented it into CAM5.3/MAM4.

Results: At high latitudes and biomass burning areas, BrC contributes explicitly to >20% of total aerosol absorption



Mass Absorption Efficiency of BrC from Biomass burning, Biofuel, and Fossil Fuel

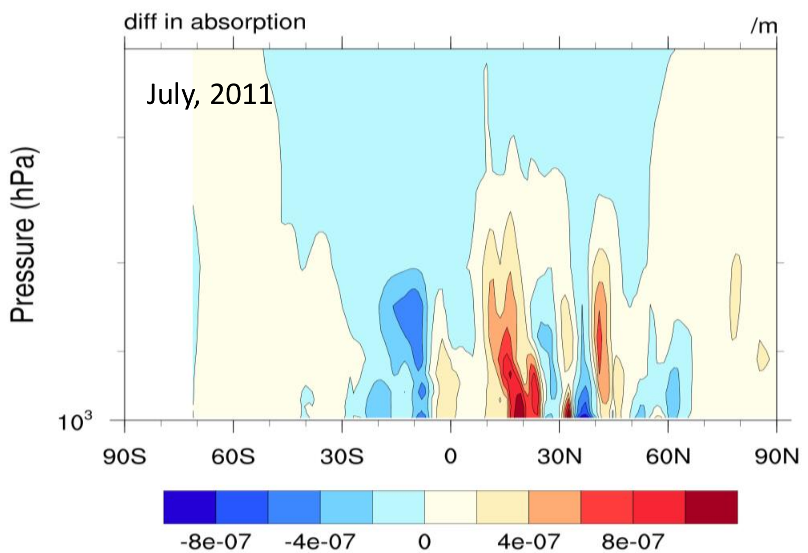


Contribution (%) to Fine-mode Absorption Aerosol Optical Depth (AAOD) due to BrC

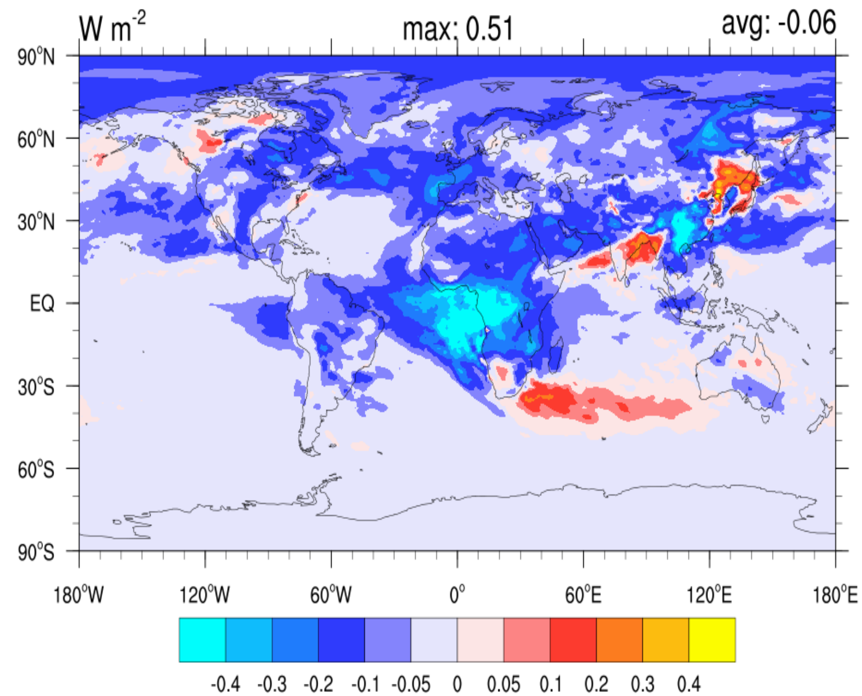
Increased Absorption by Brown Carbon

Impact on Black Carbon Radiative Effect

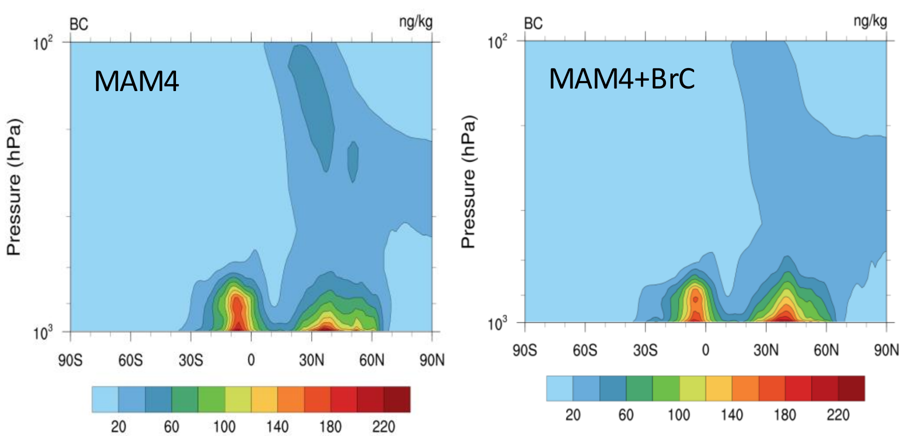
Changes in Absorption Profiles After Including BrC



Impact on Direct Radiative Effect of BC



Changes in BC Vertical Profiles



Results:

- The estimated direct radiative forcing of BC is lowered from +0.56 to 0.5 Wm^{-2}, while BrC inserts a positive forcing of +0.04 Wm^{-2}.
- This takes in account of enhanced absorption by BrC explicitly and the subsequent effects on BC transport and predicted cloud properties

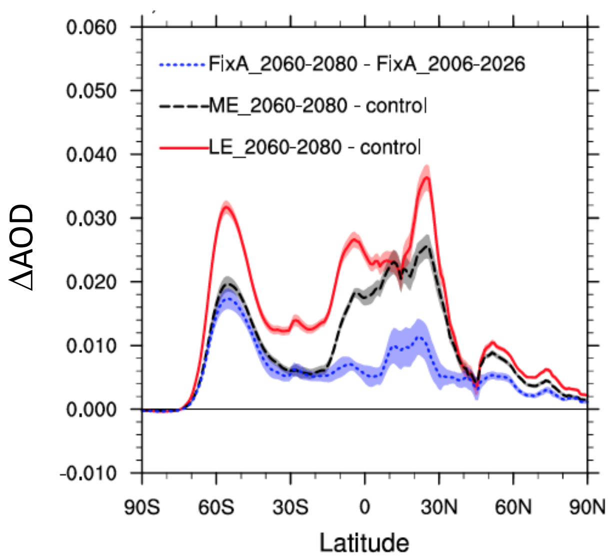
GETTELMAN

The Interaction of Aerosol Forcing & Climate Feedbacks

A. Gettelman, L. Lin[1], B. Medeiros, J. Olson (NCAR)
[1]Now at School of Atmospheric Sciences, Sun Yat-sen University, Guangzhou

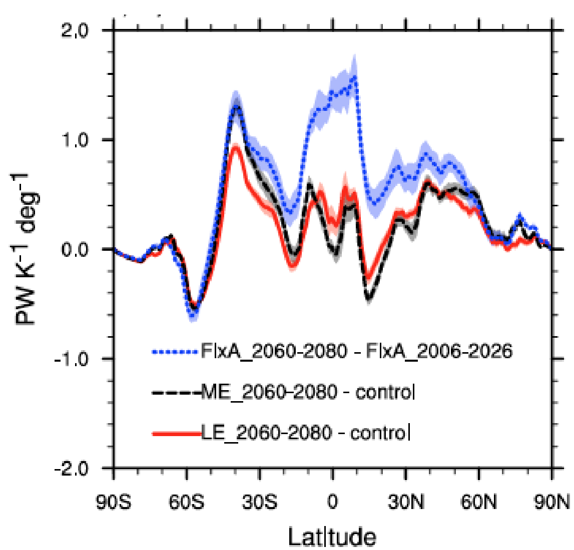
Aerosols modify cloud feedbacks, so representations of **aerosol-cloud interactions may contribute to multi-model spread** in climate feedbacks and climate sensitivity

ΔAOD Within Model Runs



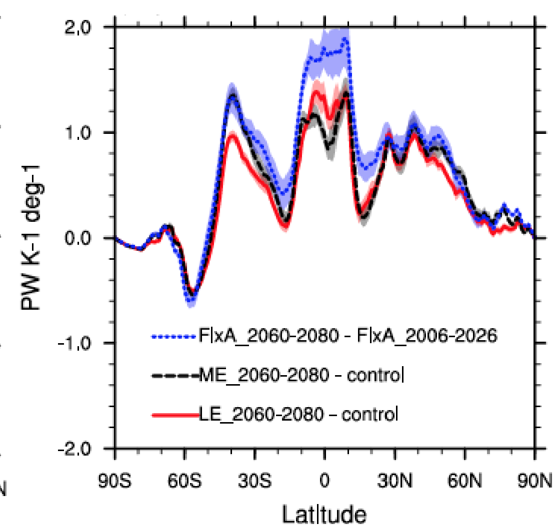
3 Different Ensembles of CESM1 with different Aerosol Emissions…

Cloud Feedbacks



Yield different cloud Feedbacks
Can correct with 'aerosol kernel'

Cloud Feedbacks
Aero Kernel Removed



Now with 'aerosol kernel' removed. Remaining differences: (1) Aerosol Feedback and (2) Aerosol effects on cloud feedback

GINOUX

AeroCom Anthropogenic Dust Experiment

Paul Ginoux
NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA

Agricultural practice has been the key factor of the infamous Dust Bowl of the 1930s (Lee and Gill, 2015), and through positive feedback may have amplified the drought in the Midwest (Cook et al., 2008). There is widespread evidence of wind erosion from anthropogenic emissions from cropland and pasture, but its contribution to global emission is highly uncertain. Model based estimations vary from negligible to 60% globally. Satellite based estimation is around 25% (Ginoux et al., 2012). It would be assumed that direct observation of dust events would reduce uncertainties. Unfortunately, this is not the case.

The objective is to present major uncertainties associated with modeling anthropogenic dust from agriculture, and how they may be reduced with a little help from AeroCom modelers.

During the 14th AeroCom workshop (Frascati, October 2015), an "Anthropogenic Dust Experiment" was presented. Preliminary results are analyzed and improvements are suggested.

GOTO

Daisuke GOTO : # "High resolved aerosol simulations using (NICAM)"

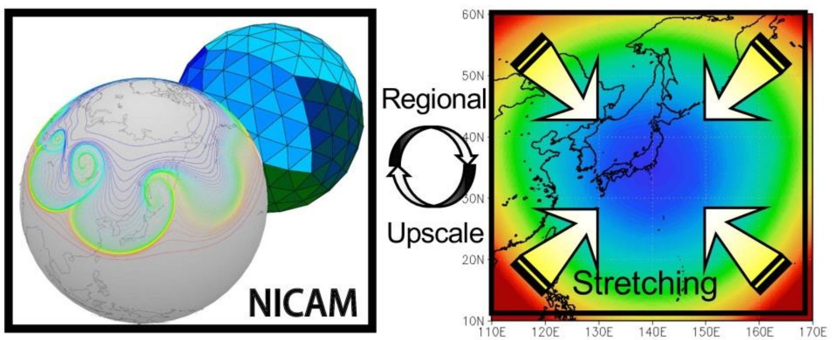
Background : Climate & Social issues of air pollution in both global and regional scales

Objectives : Development of atmospheric modeling for the air pollution

Method : Use of **"NICAM-Chem"** with uniform or stretched grid system

Feature : Covering global-through-regional scales with high spatial resolutions

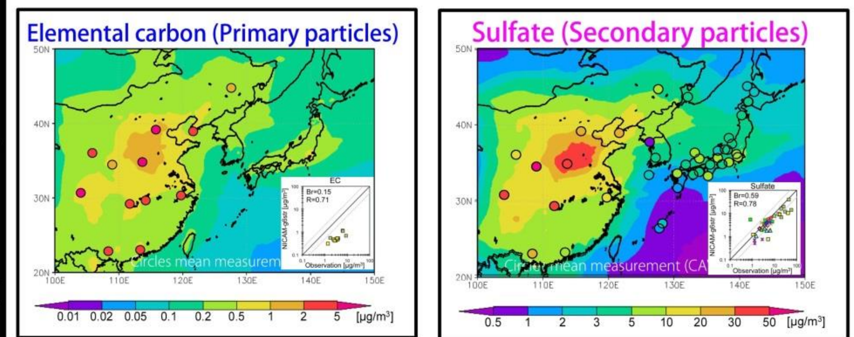
Nonhydrostatic ICosahedral Atmospheric Model



Tomita and Satoh [2004], Satoh et al. [2008, 2014]

Air pollution modeling

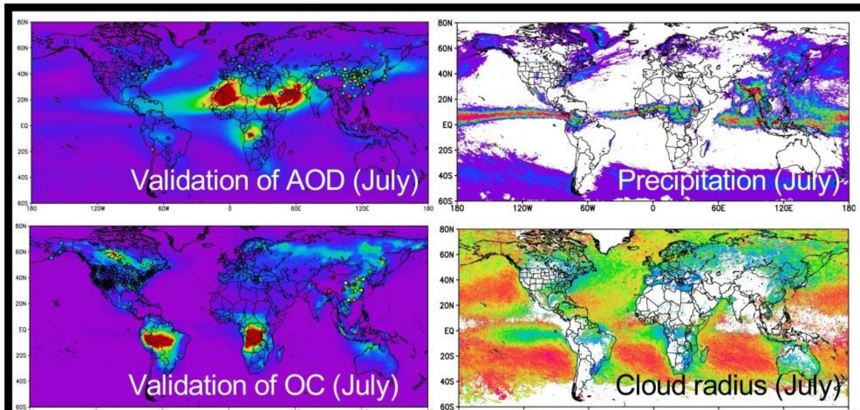
Validation of aerosols over East Asia



Goto [2014], Goto et al. [2015]

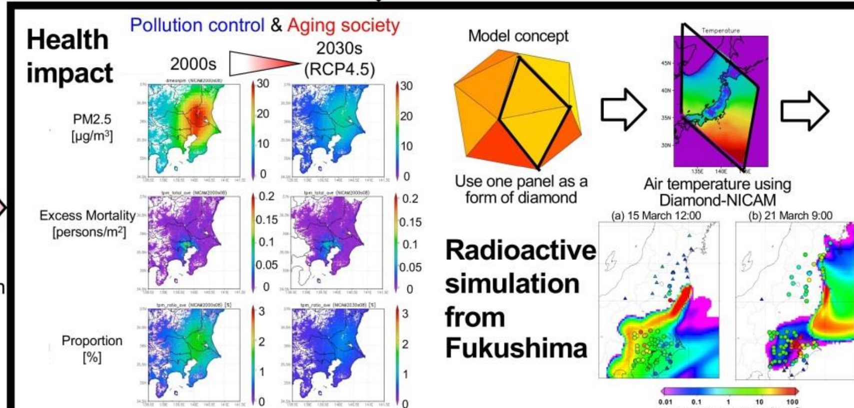
Upscaling

Application



Goto et al. [in prep.]

Application



Goto et al. [2016]

Nakajima et al. [in rev.]

Using the stretched grid system on NICAM with 10 km grids, we simulated aerosol distributions over East Asia. After the validation, we are simulating them in a global scale with high resolution (dx=O(10km)) on K computer.

GRIESFELLER

Norwegian
Meteorological
Institute

The AeroCom infrastructure in a changing IT environment

Michael Schulz and **Jan Griesfeller** / Met Norway

26.09.2016

JAYAWARDENA

15th AeroCom and 4th AeroSAT workshops and 15th CTWF international symposium on atmospheric aerosol

Beijing, China, 19-27 September 2016

Numerical simulation of air pollution dispersion in a lee side wake A case study at south western part of Sri Lanka

H. K. Wasana Isuri Jayawardena[1], Leif Enger[2]

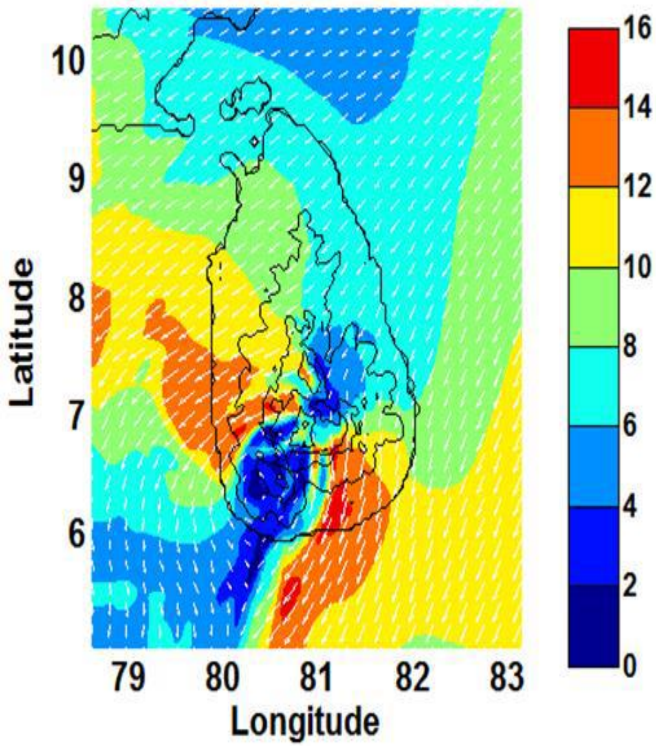
Department of Physics, The Open University of Sri Lanka, Sri Lanka,

[2] International Science Program, Uppsala University, Sweden a

UPPSALA UNIVERSITET

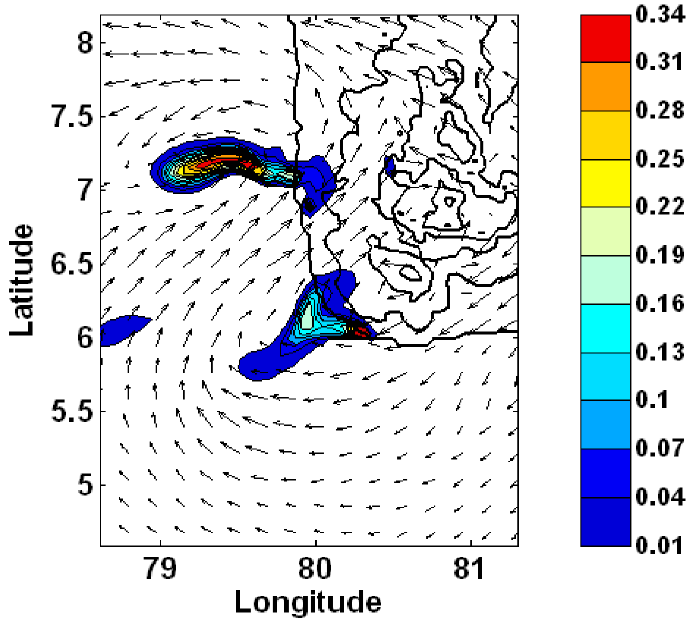
The Study

The effects of lee side wake, vortices and the central mountain area on **dispersion of air pollutants** were examined using meso-scale simulations.



The method

Simulations of pollutant concentrations of 2 area sources and other weather fields were made with the MIUU-model (Meteorological Institute Uppsala University model).



The Results

The simulations showed **accumulation of air pollutants in the wake vortices**.

The Outcome

The influence of complex terrain especially the significant control of central mountain area on air pollutant dispersion and ambient air quality over southwestern part of the Sri Lanka was identified. The results can be used in air quality impact assessments in Sri Lanka.

KINNE

BC
impact on climate

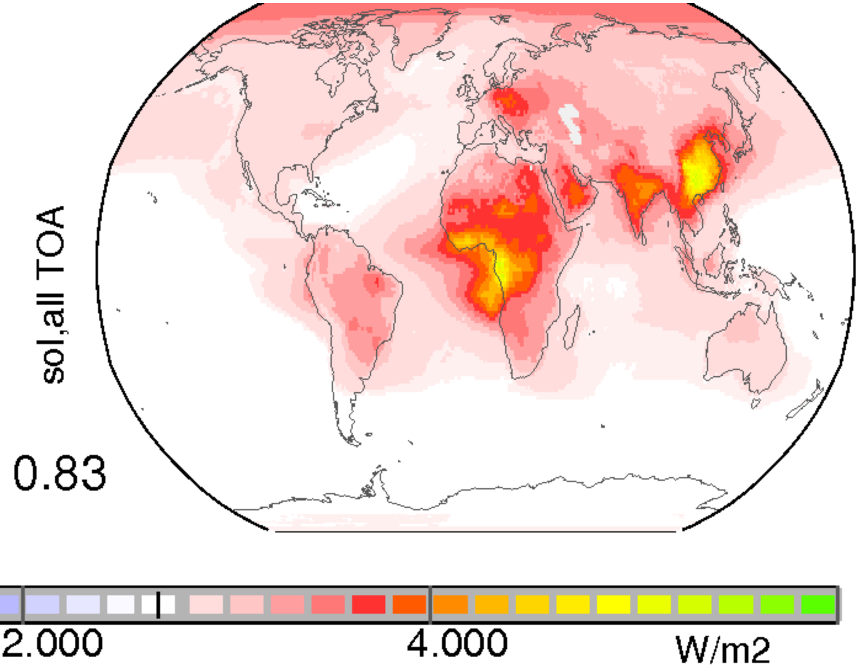
direct BC (ToA) forcing

*.. constrained by **AERONET** absorption "observations"*

- highly variable

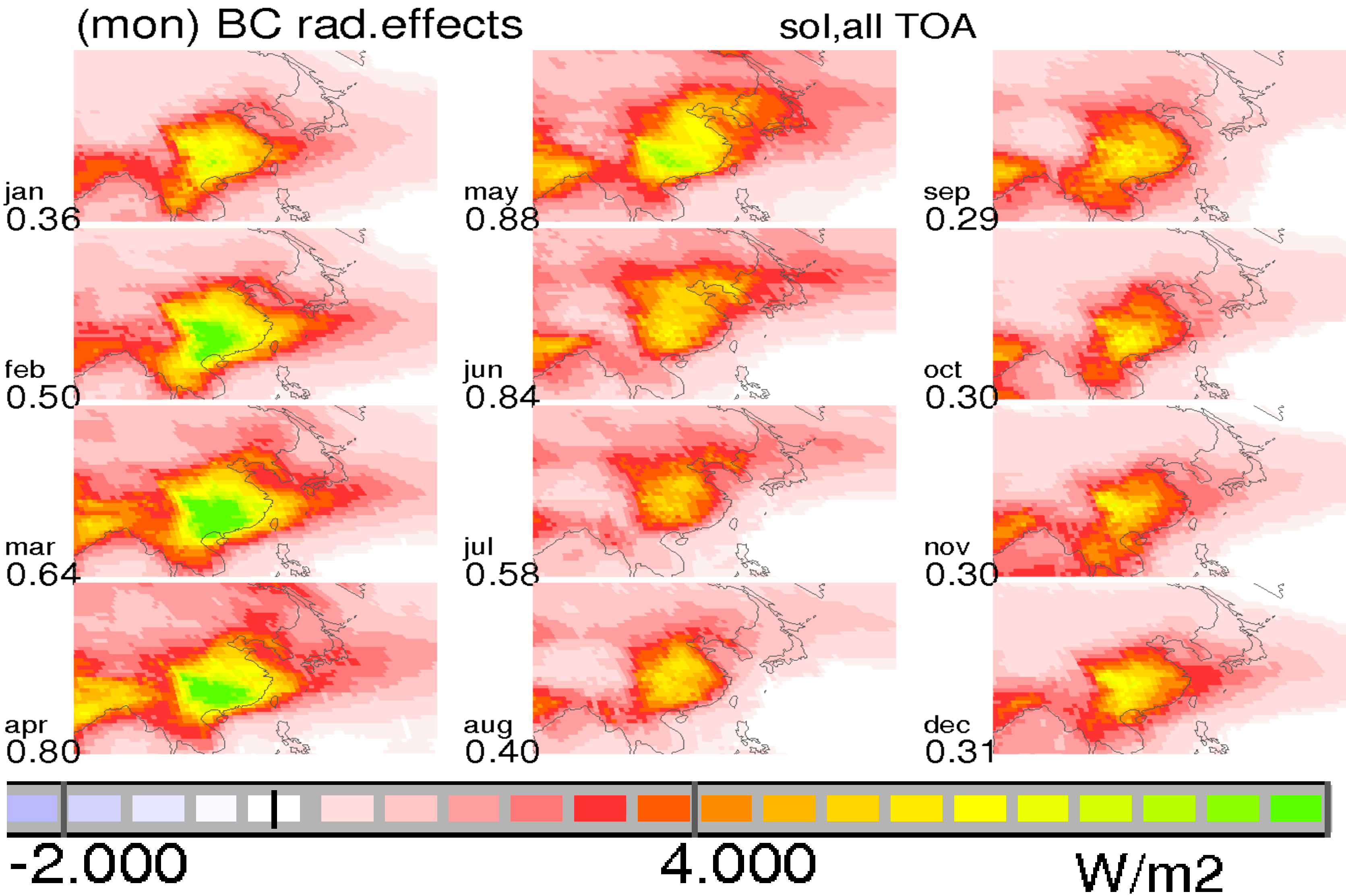
- global annual **WARMING**
  today;s BC ~ 0.8 W/m2
  anthrop BC ~ **0.7 W/m2**

  all ant. aerosol still **cools**



Stefan Kinne, *MPI-Meteorology*

strong variability – also over China

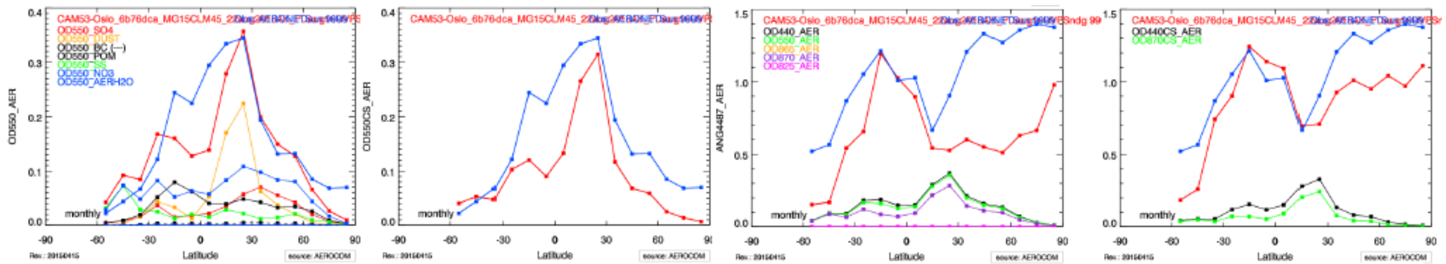


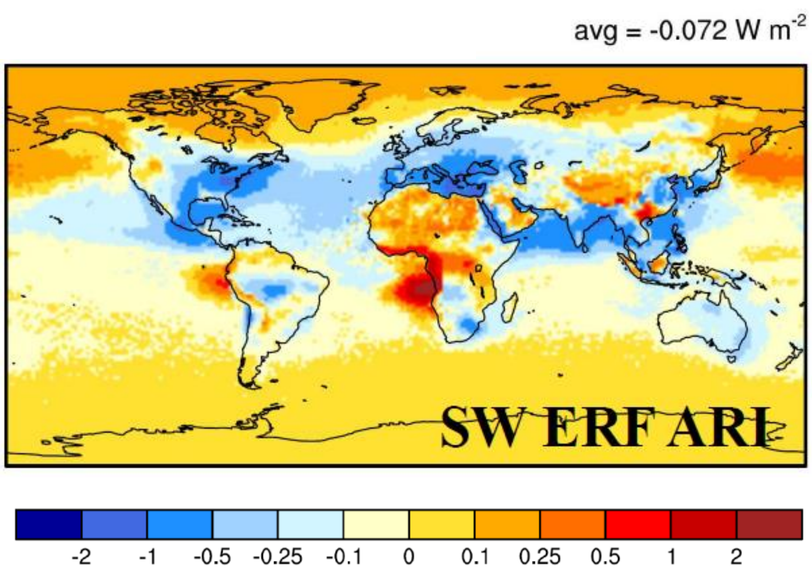
KIRKEVAG

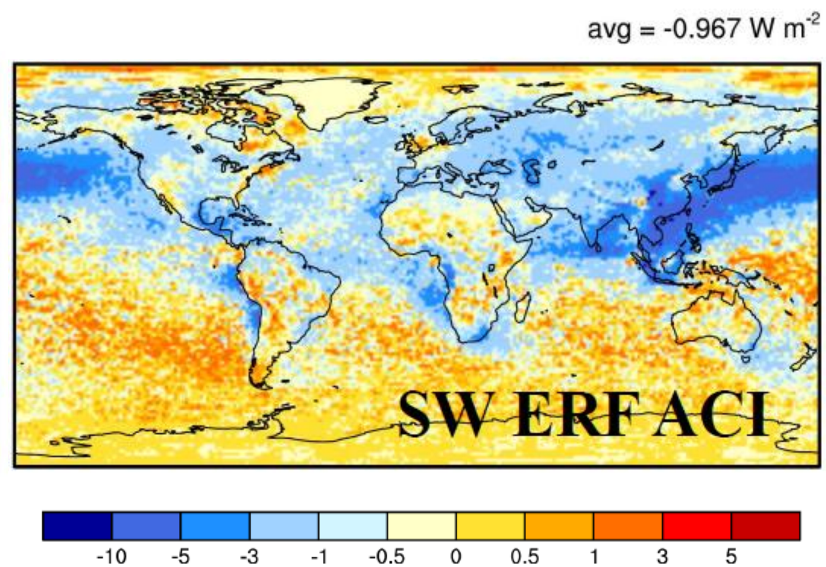
Aerosol validation and effective radiative forcing estimates from a preliminary version of CAM5-Oslo

A. Kirkevåg, K. Alterskjær, A. Grini, M. Hummel, T. Iversen, I. H. Karset,
J. E. Kristjánsson, A. Lewinschal, D. Olivié, M. Schulz, and Ø. Seland

all-sky AOD vs. **clear-sky AOD** **all-sky ANG** vs. **clear-sky ANG**







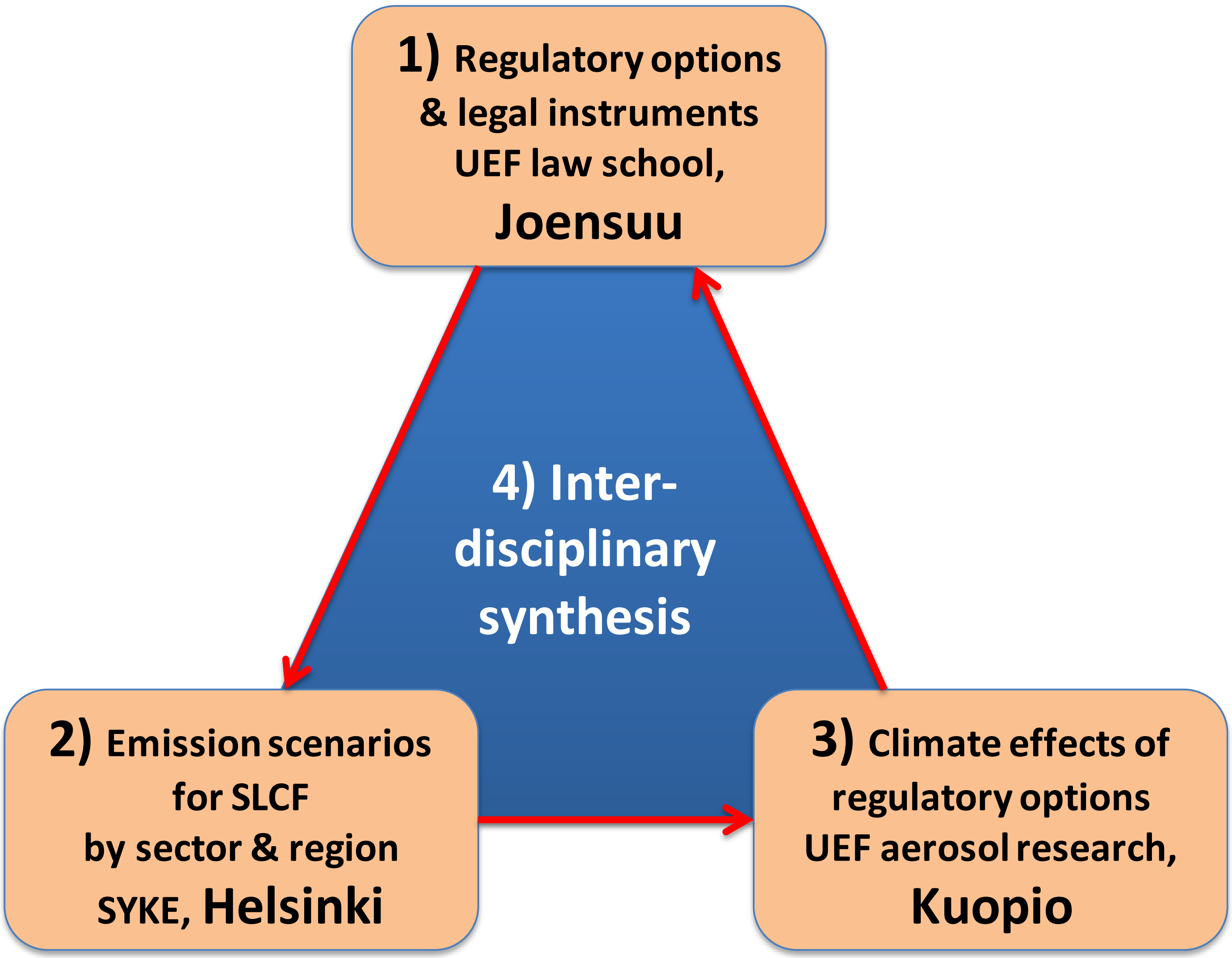
KOLACHI

KUEHN

MODELLING BLACK CARBON: FROM INTERNATIONAL CLIMATE LAW TO IMPACT ON ARCTIC CLIMATE

Thomas Kühn, H. Kokkola, K. Kupiainen, K. Kulovesi, and K.E.J. Lehtinen

UNIVERSITY OF EASTERN FINLAND

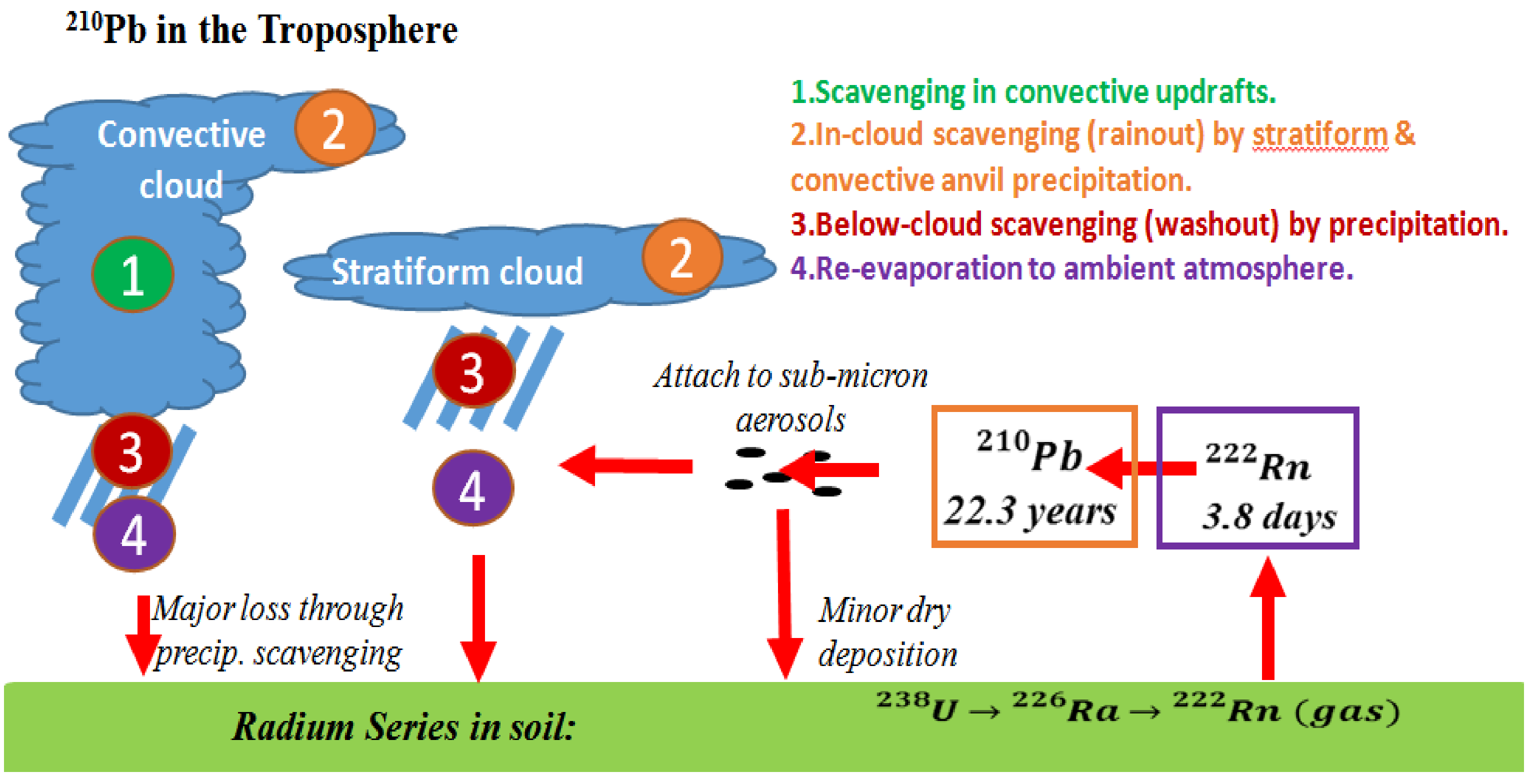

1) Regulatory options
& legal instruments
UEF law school,
Joensuu
4) Inter-
disciplinary
synthesis
2) Emission scenarios
for SLCF
by sector & region
SYKE, Helsinki
3) Climate effects of
regulatory options
UEF aerosol research,
Kuopio

LIU

Constraints From Airborne ^{210}Pb Observations on Aerosol Scavenging and Lifetime in a Global Chemical Transport Model

Bo ZHANG[1] (bo.zhang@nianet.org), Hongyu LIU[1] (hongyu.liu-1@nasa.gov), James H. CRAWFORD[2], Duncan T. FAIRLIE[2], Gao CHEN[2], Jack E. Dibb[3], Viral SHAH[4], Melissa P. SULPRIZIO[5], and Robert M. YANTOSCA[5]

[1] National Institute of Aerospace, Hampton, VA, USA, [2] NASA Langley Research Center, Hampton, VA, USA
[3] University of New Hampshire, Durham, NH, USA, [4] University of Washington, Seattle, WA, USA [5] Harvard University, Cambridge, MA, USA



- The **aerosol scavenging parameterization** in GEOS-Chem has recently been modified (e.g., scavenging in ice clouds);
- **Availability of ^{210}Pb profiles** worldwide measured during NASA aircraft campaigns **over the past two decades** for constraining aerosol scavenging & lifetime.

MICHOU

Improvement of the representation of sea-salt aerosols in CNRM-CM

P Nabat [1] *(pierre.nabat@meteo.fr), M Michou* [1]*, L Watson* [1] *and D Saint-Martin* [1]

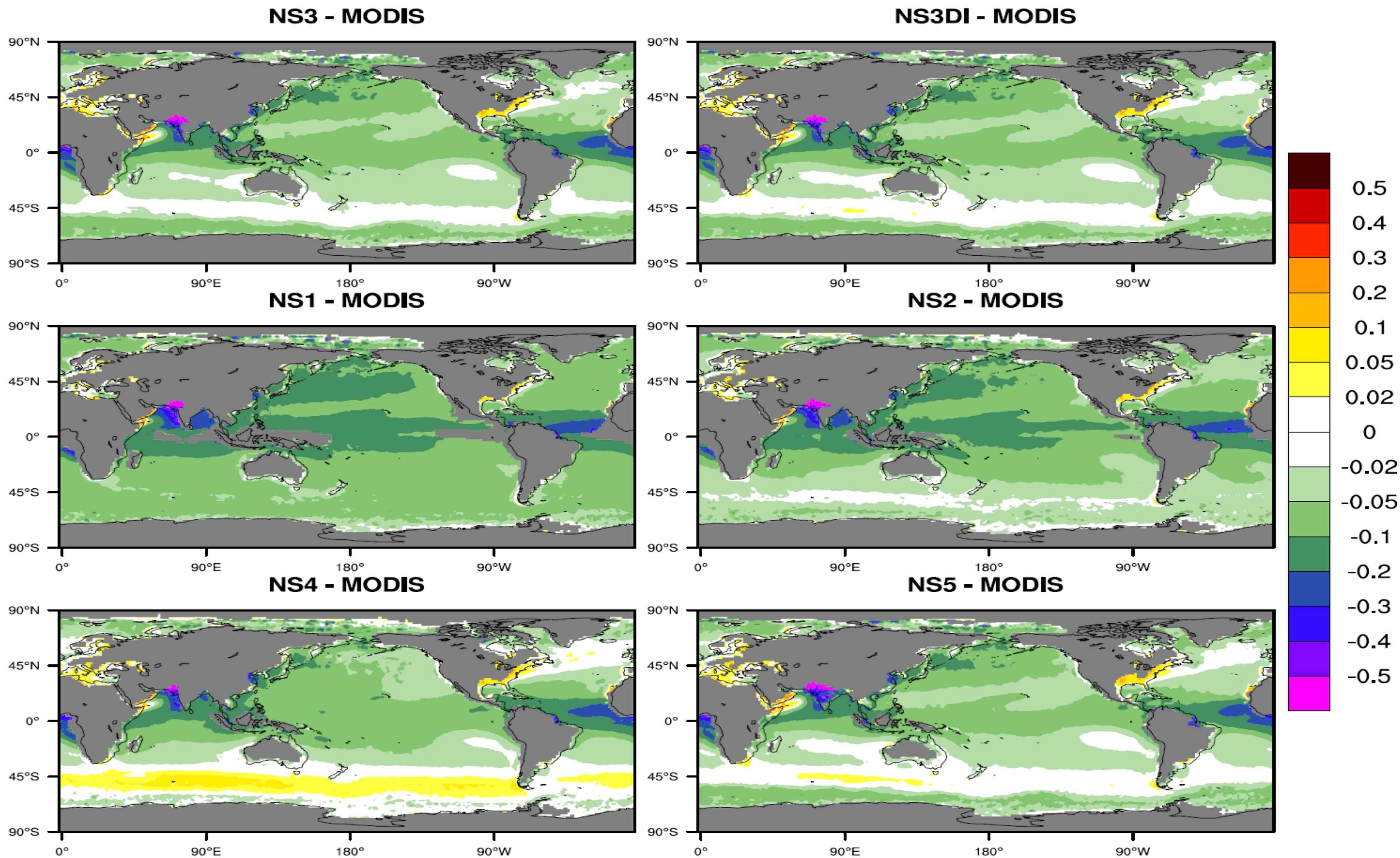
[1] *Météo-France / CNRM, UMR-3589, 42 avenue Gaspard Coriolis, Toulouse (France)*

This study has shown the **strong impact** of the **choice of sea-salt emission scheme** on the representation of sea-salt aerosols in CNRM-CM.

The comparison with different observations reveals that **seasalt emission depend** not only on ***near-surface wind speeds*** but also on ***SST*** and ***the growth of particles with humidity***

(considering all dependencies improves the aerosol scheme)

However, **surface sea-salt concentrations** seem to be **still overestimated**, and some biases have been identified in several locations. An evaluation with radiative fluxes will be added in the following work. The dependence of sea-salt emission on waves could also be tested.

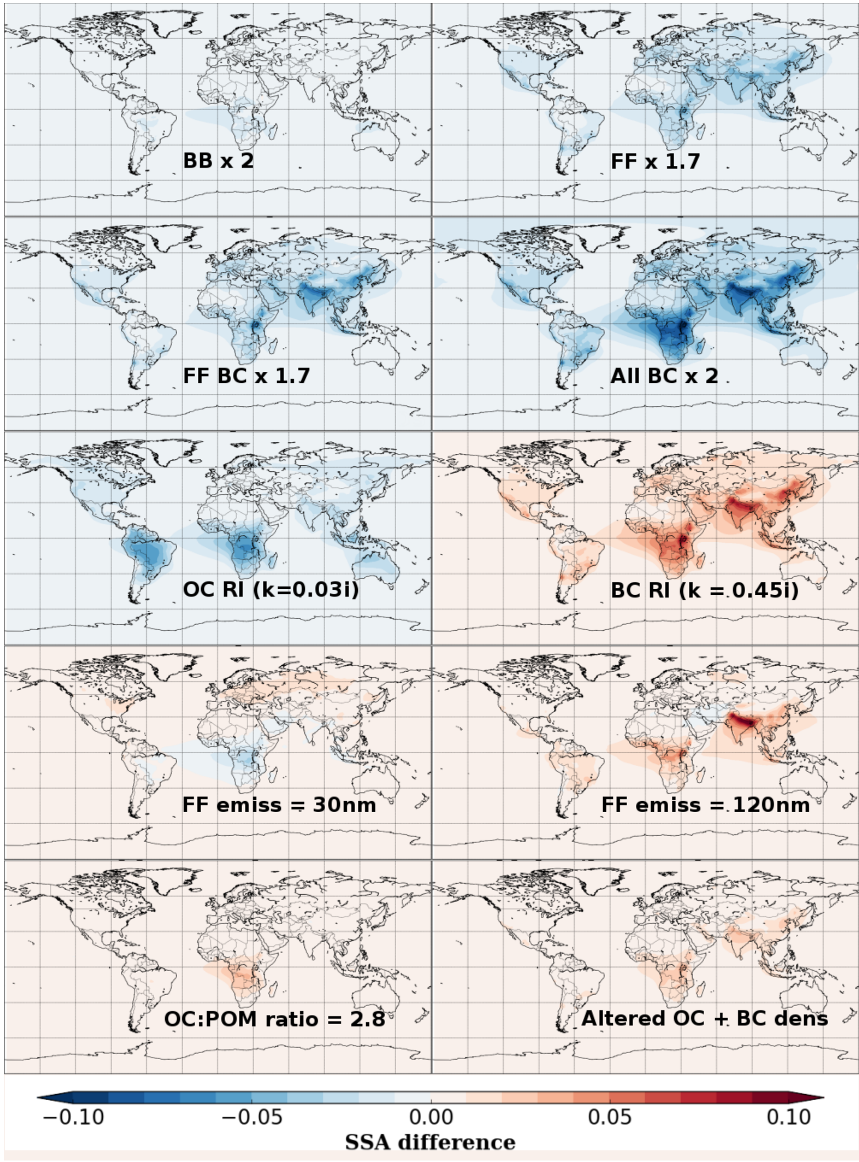


Average total AOD difference at 550 nm between CNRM-CM simulations and MODIS data.
(only points where sea-salt AOD > 0.01 are shown)

MOLLARD

Multiple observational constraints on carbonaceous aerosol absorption in HadGEM

James Mollard, Nicolas Bellouin, Ellie Highwood, Ben Johnson
(University of Reading & UK Met Office)



- Use the limitations of AERONET level 2 absorption products to **compare optically thick events**
- Assess the **single scattering albedo** and **Angstrom Exponent** of HadGEM3-UKCA
- We determine an effective method of improving carbonaceous aerosol in HadGEM3

is it a single MASS-ive solution?

or something more complex?

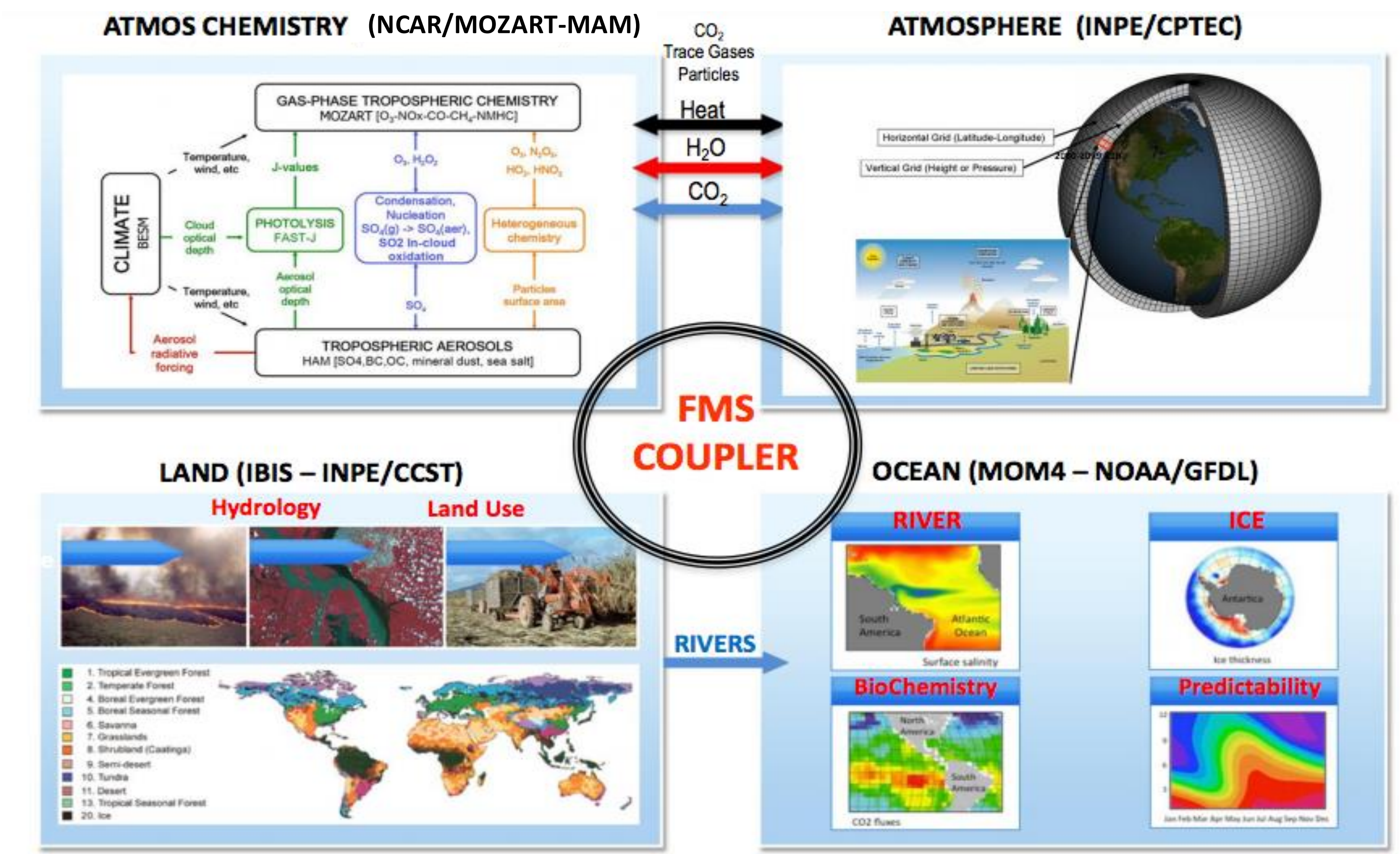
NOBRE

Radiation fluxes in the Brazilian Global Atmospheric Model Using RRTMG radiation scheme

<u>NOBRE</u>; ALVIM; ENORÉ; FIGUEROA; SILVA; KUBOTA; CAPISTRANO.

National Institute for Space Research - INPE,

15th CAS-TWAS-WMO Forum – *Beijing, China 19-23 September 2016*

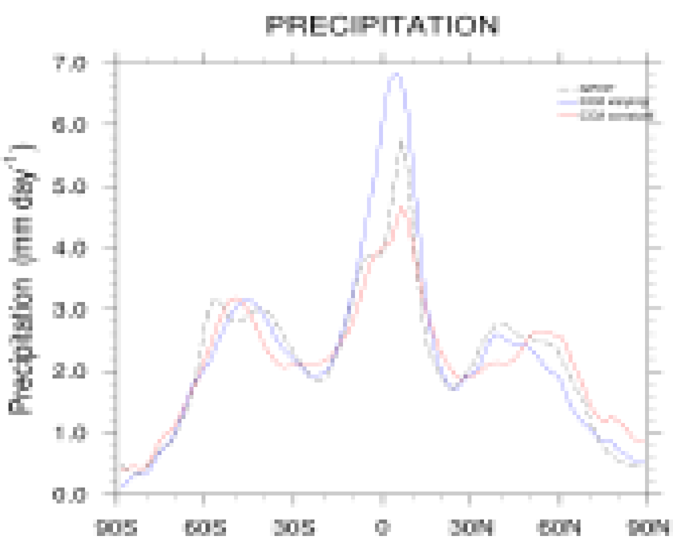


Radiation fluxes in the Brazilian Global Atmospheric Model

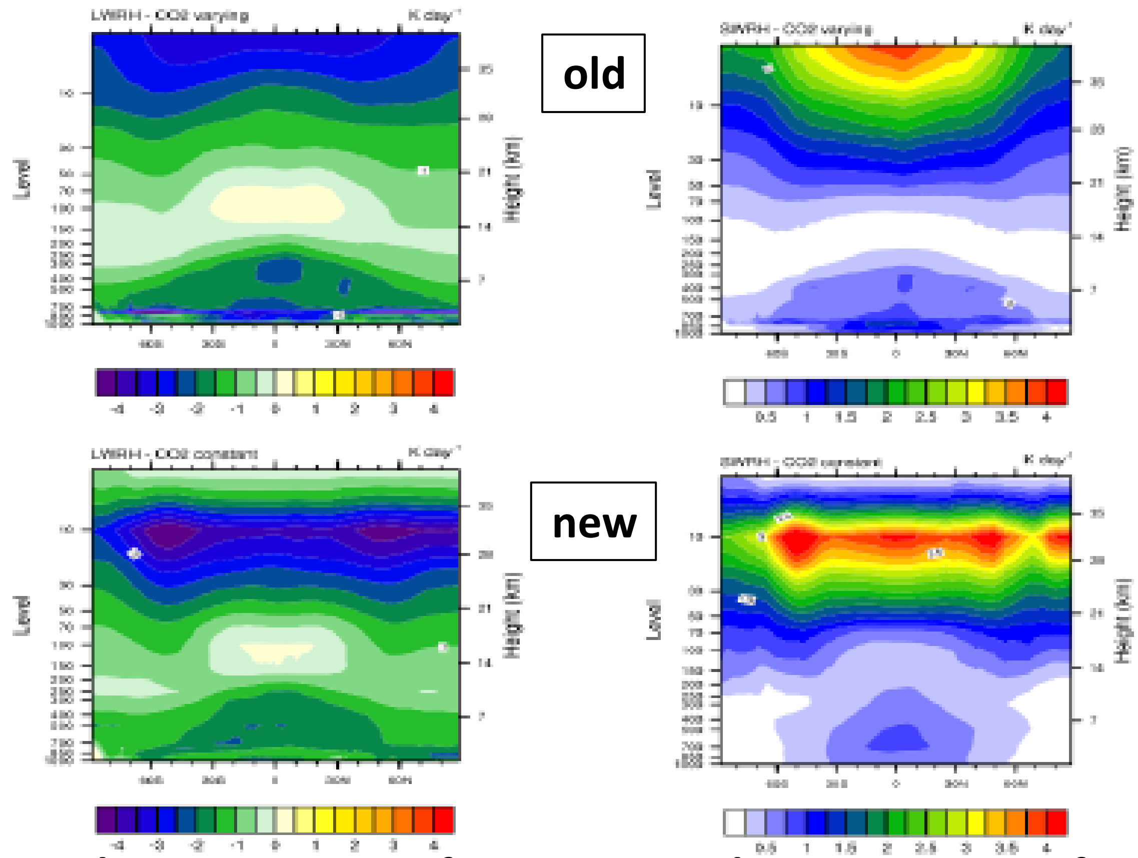
using RRTMG radiation scheme

1*NOBRE P.; ALVIM, D. S. 1, ENORÉ, D1; FIGUEROA, S. N.1; SILVA, J.1; KUBOTA, P. Y.1; CAPISTRANO, V. B.1

*1 National Institute for Space Research - INPE, Cachoeira Paulista, SP, Brazil, *e-mail: paulo.nobre@cptec.inpe.br*



imapct on zonlaly mean precip



longwave HR prof. **shortwave HR prof.**

CONCLUSIONS

- better representation of (spatially varying) CO_2 concentrations lead to improved longwave and shortwave radiative heating rate profiles

NWOFOR

AEROSOL LOADING IN THE NIGERIAN SUB-SAHEL:
ANALYTICAL DEDUCTIONS FROM AERONET DATA

Okey. K. Nwofor[1,2*], N. D. Onyeuwaoma[1,4], V. N. Dike[1,2,3] , U. K. Okoro[1] and T. C. Chineke[1],

[1]Atmospheric Physics Group, Department of Physics, Imo State University, PMB 2000, Owerri, Nigeria.

[2]International Center for Climate and Environment Sciences, Institute of Atmospheric Physics, Chinese Academy of Science, Beijing 100029, China.

[3]Centre for Renewable Energy Research and Development, Imo State Polytechnic Umuagwo, P.M.B 1472 Owerri, Nigeria.

[4] Center for Basic Space Science, NASRDA, University of Nigeria

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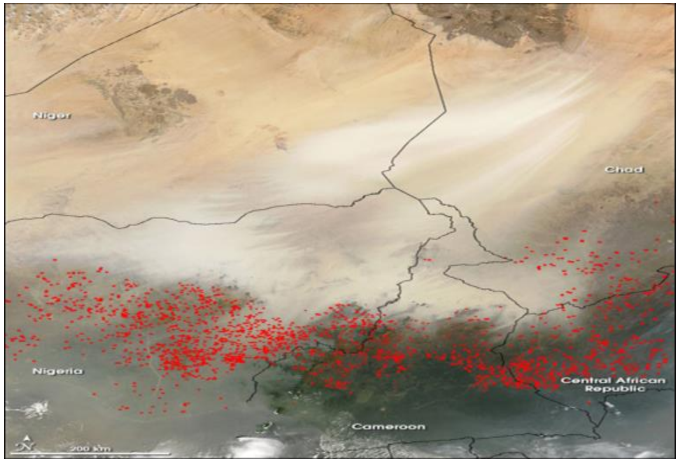
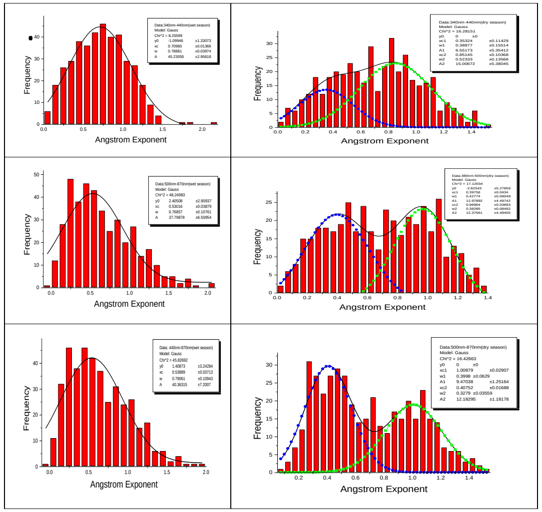
5 Center for Monsoon Research, Institute of Atmospheric Physics, Chinese Academy of Science, Beijing

*e-mail: okeynwofor@yahoo.com



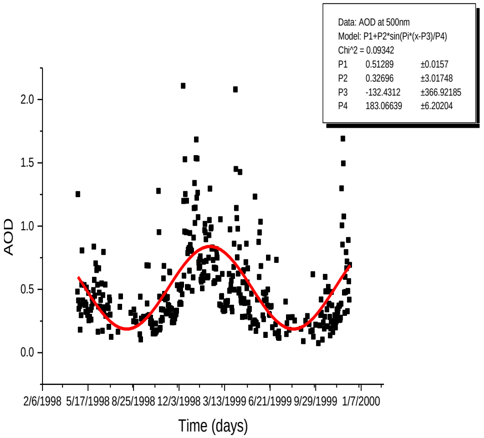
Results: Inferring Particle Types using AE curvature



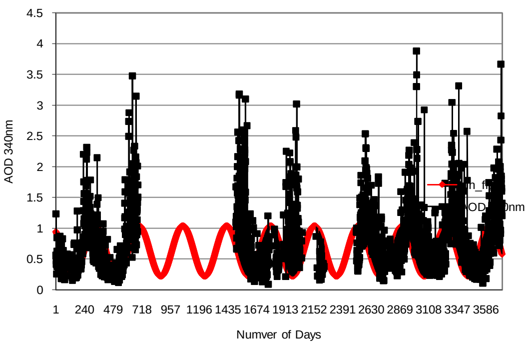
- AE values ≥1 indicates small particles associated with combustion by-products like biomass burning aerosols
- AE values ≤1 indicates large particles such as dust

Results: Projection of seasonality to the long-term as a way of observing perturbations and loading episodes

$$Y(t) = P_1 + P_2 \sin\left[\frac{\pi(x-P_3)}{P_4}\right]$$

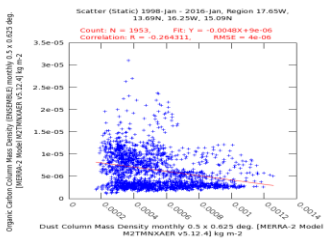


seasonal modulation amplitude for the peak solar wavelength (AOD $_{500nm}$) of 0.327 over an annual mean value of 0.513.

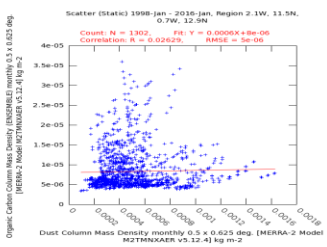


Very stable seasonality

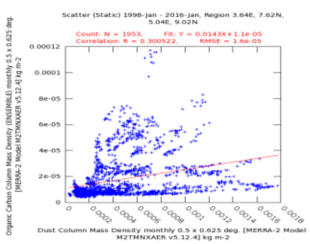
Results: Aerosol mixture is almost 50:50 for dust and biomass burning aerosols -in the dry season: Curvature is most pronounced when there is clear dominance of one fraction; as in last quarter of 1998-2016 when biomass burning decreased considerably



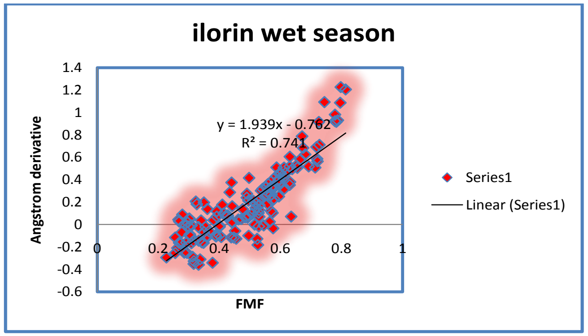
Dakar

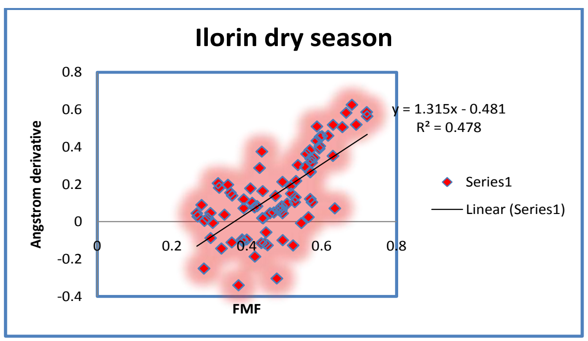


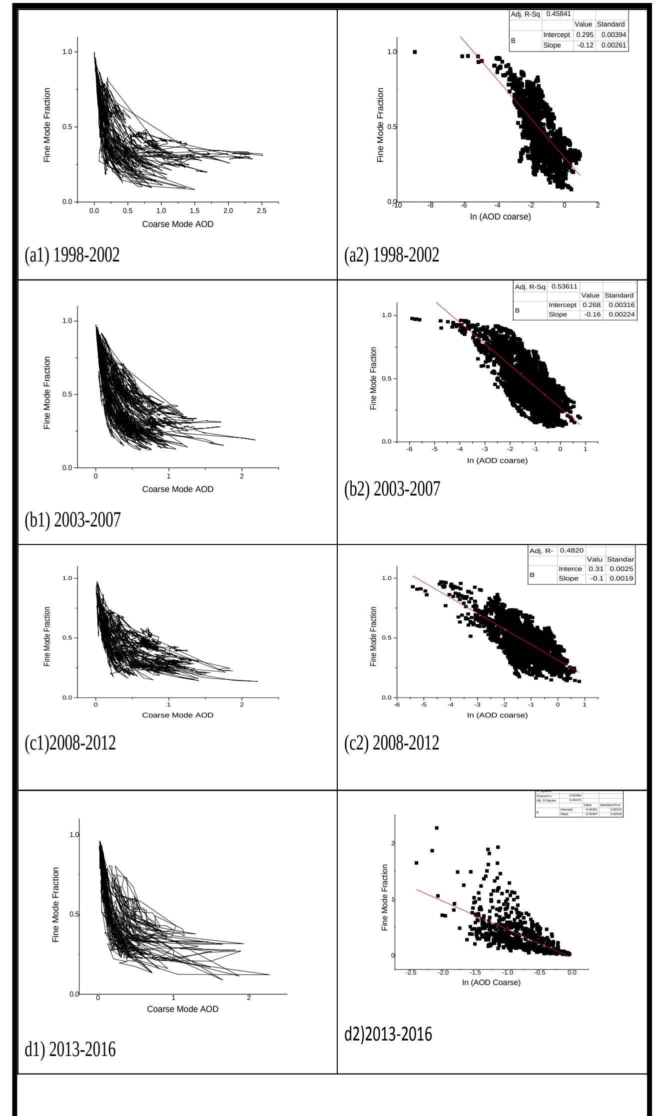
Ougadougou

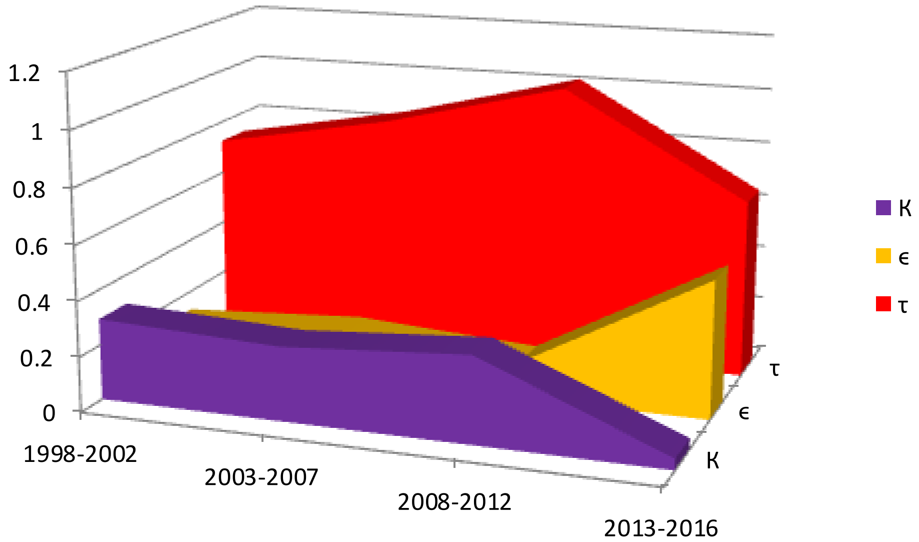


Ilorin





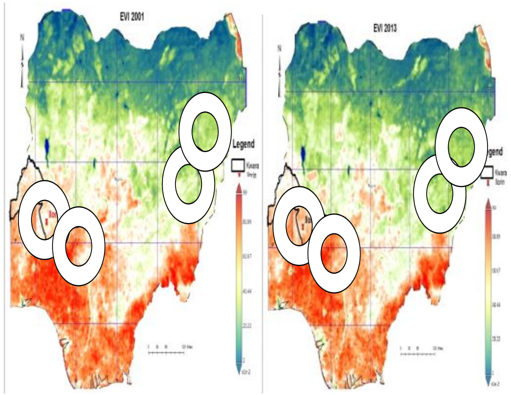




RESULTS

Although long-term AOD is decreasing at the site, evaluating long-term change in dust and biomass aerosols using curvature analysis shows that presently dry season AOD is almost completely populated by dust- This has a lot of implications for modeling

<u>Results:</u> What is causing more dust fraction and less fine mode fraction Greening or Desertification?(NASA EVI)



❖Greening along part of the south-west

❖Desertification in other parts of the sub-Sahel

❖Desertification along the north-east axis and indeed much of the Sahel

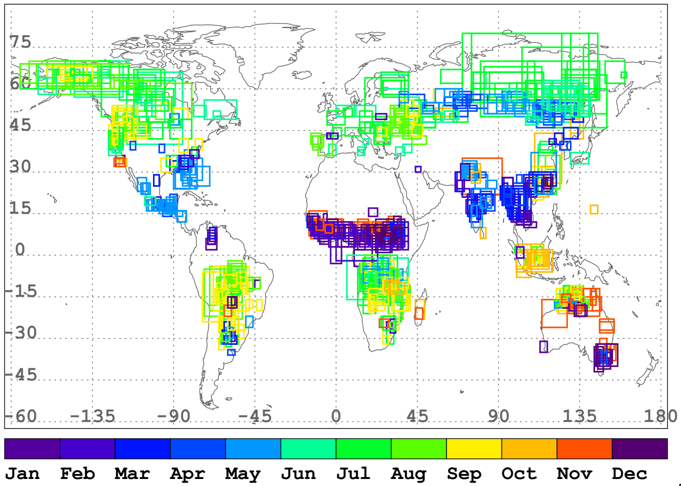
CONCLUSIONS

- **The Ilorin AERONET site captures the interesting loading scenario in sub-Sahel West Africa**
- **The seasonality is considerably stable, responding to well- known climate parameters enabling quantification of high AOD episodes**
- **The aerosol FMF which previously underestimated is very significant in the dry season**
- **The AOD is decreasing in the last five years owing to significant drop in biomass burning aerosols**
- **In the last five years, fine mode fraction is considerably large and dust diminishing**

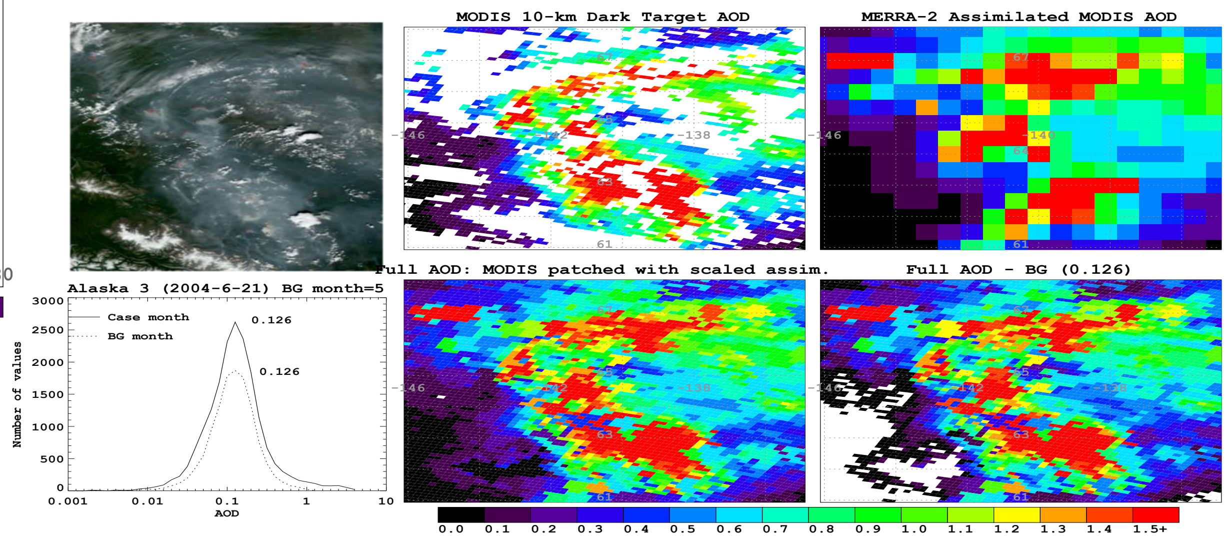
PETRENKO

Biomass Burning Emission Adjustment Factors for (AeroCOM) models

Mariya M. Petrenko (mariya.m.petrenko@nasa.gov), Ralph Kahn, Mian Chin, Maria Val Marrtin



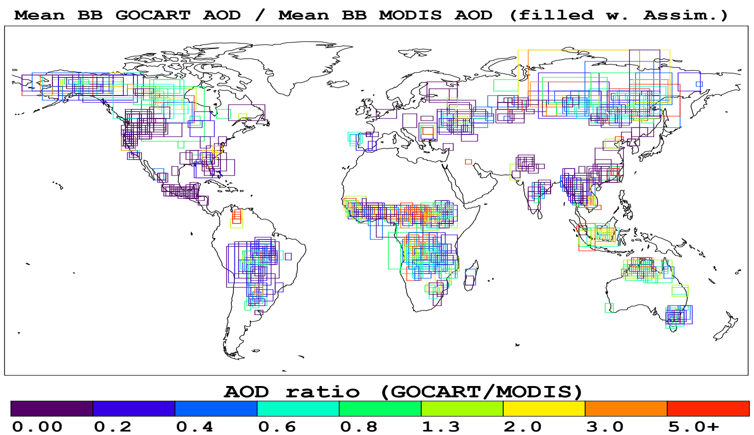
Locations of Biomass burning cases in the 2004, 2006-2008 **Reference Observational Dataset** colored by the month when case was observed by MODIS

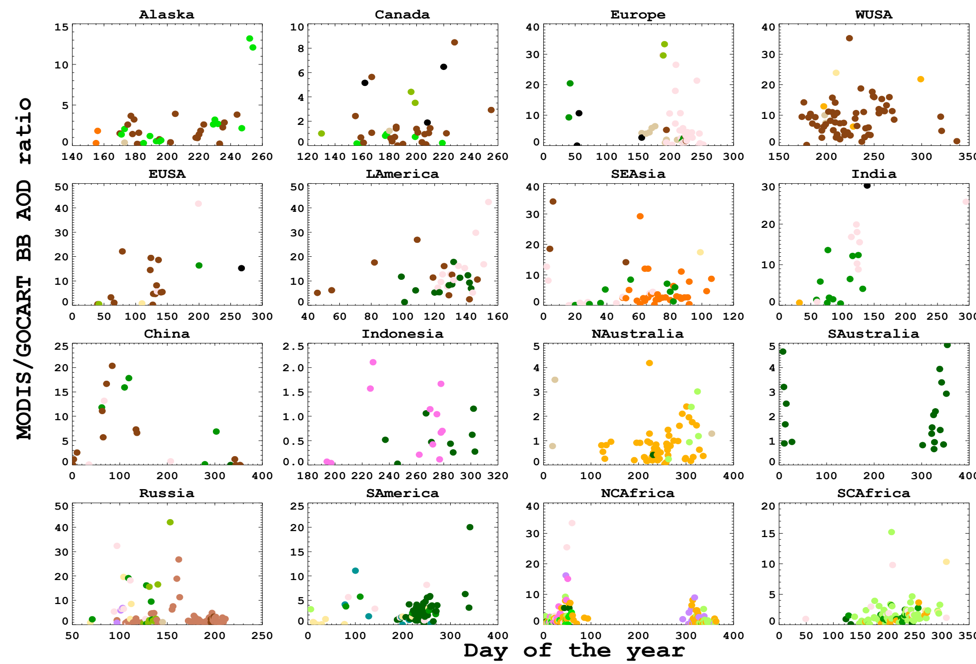


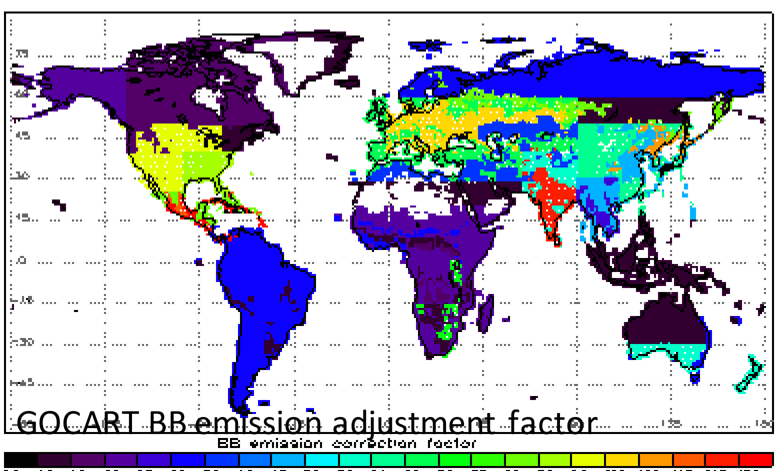
Deriving MODIS biomass burning (BB) AOD sample case: Alaska, June 21, 2004.

Using GOCART output with MODIS BB AOD **to obtain BB emission adjustment factors**

Mariya M. Petrenko, Ralph Kahn, Mian Chin, Maria Val Marrtin

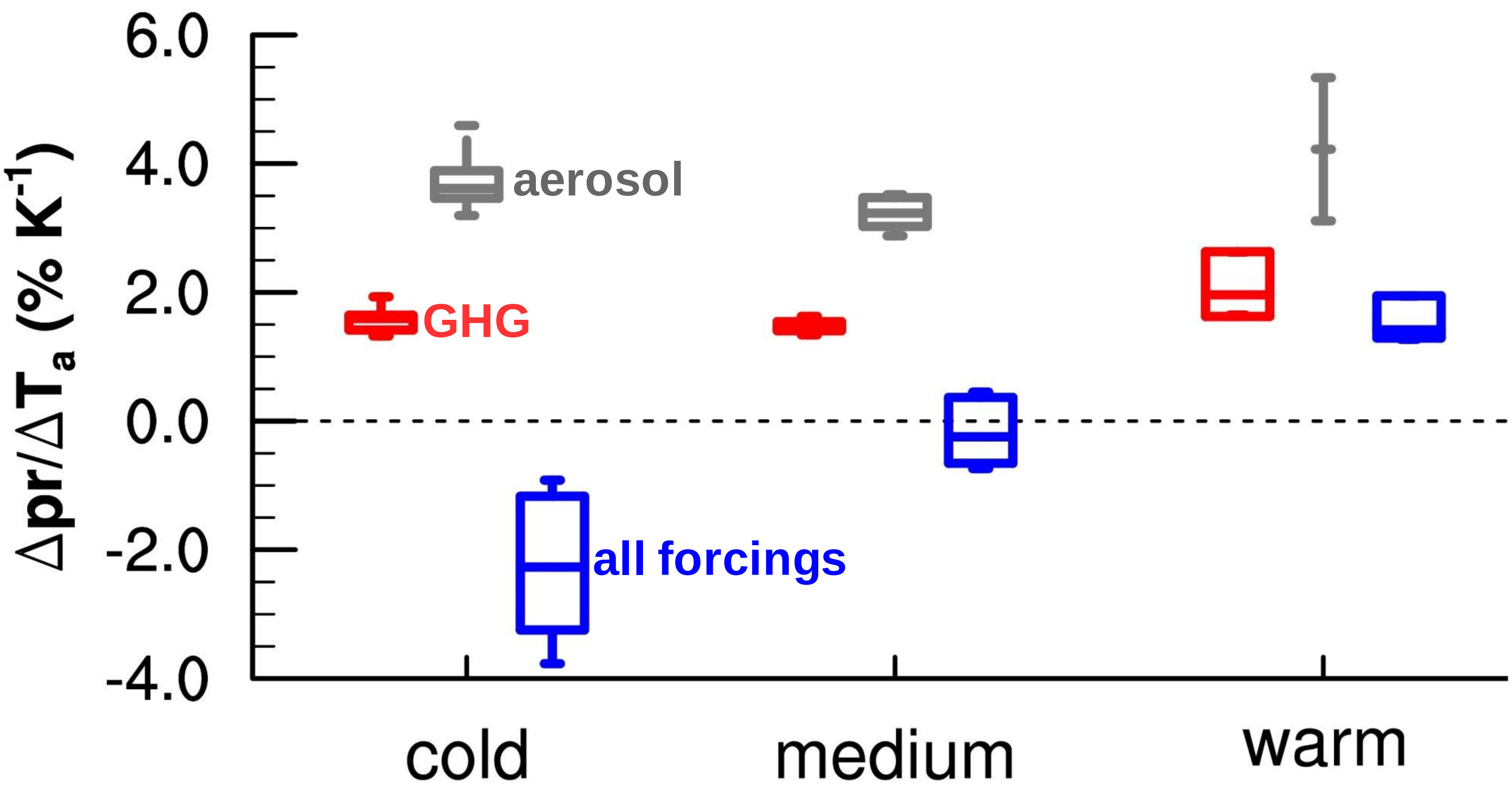






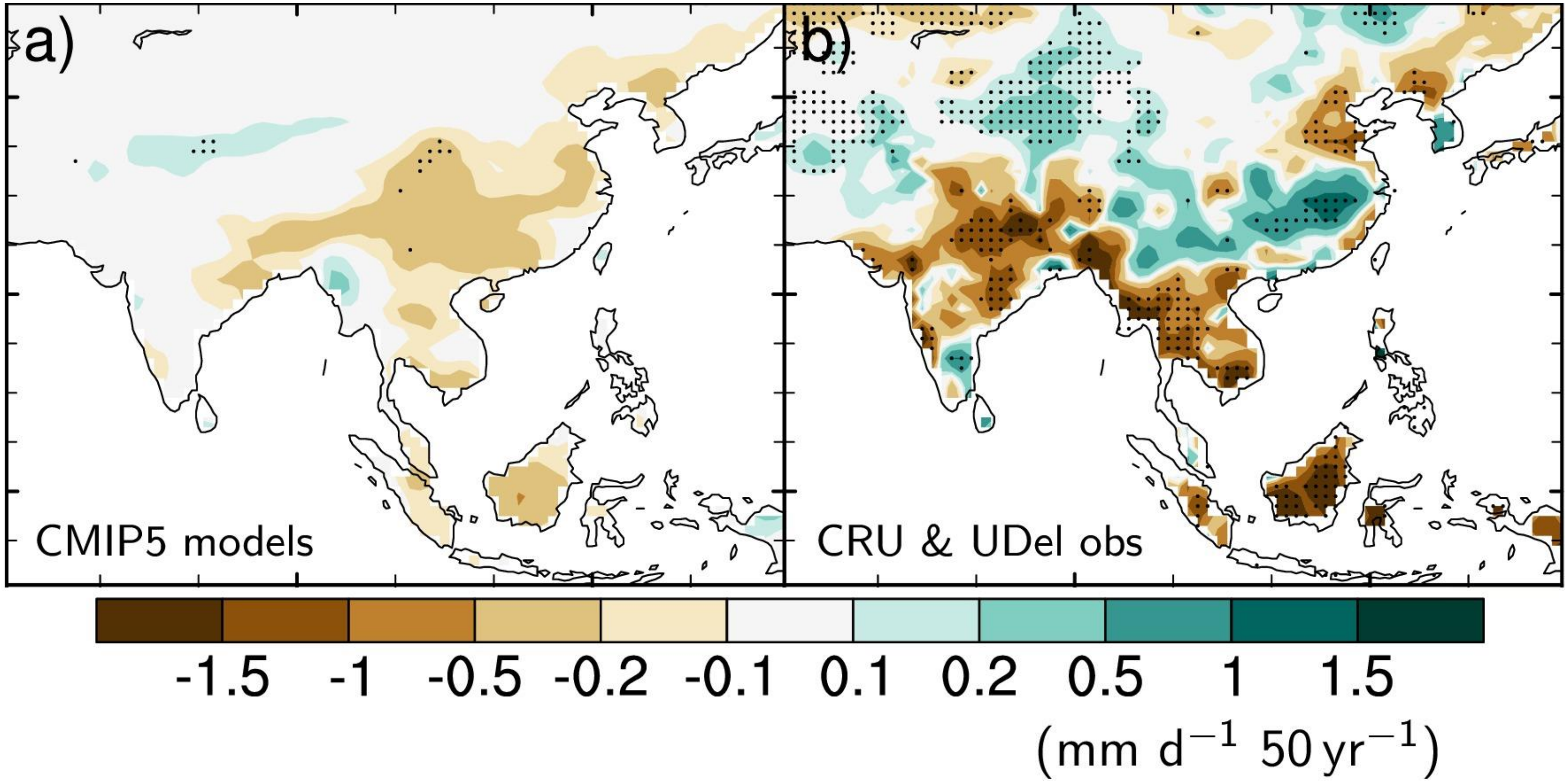
SALZMANN

Percentage **change in precipitation** per K temperature change based on CMIP5 historical runs



Source: doi: 10.1126/sciadv.1501572

1950-2000 JJAS **rainfall trend**



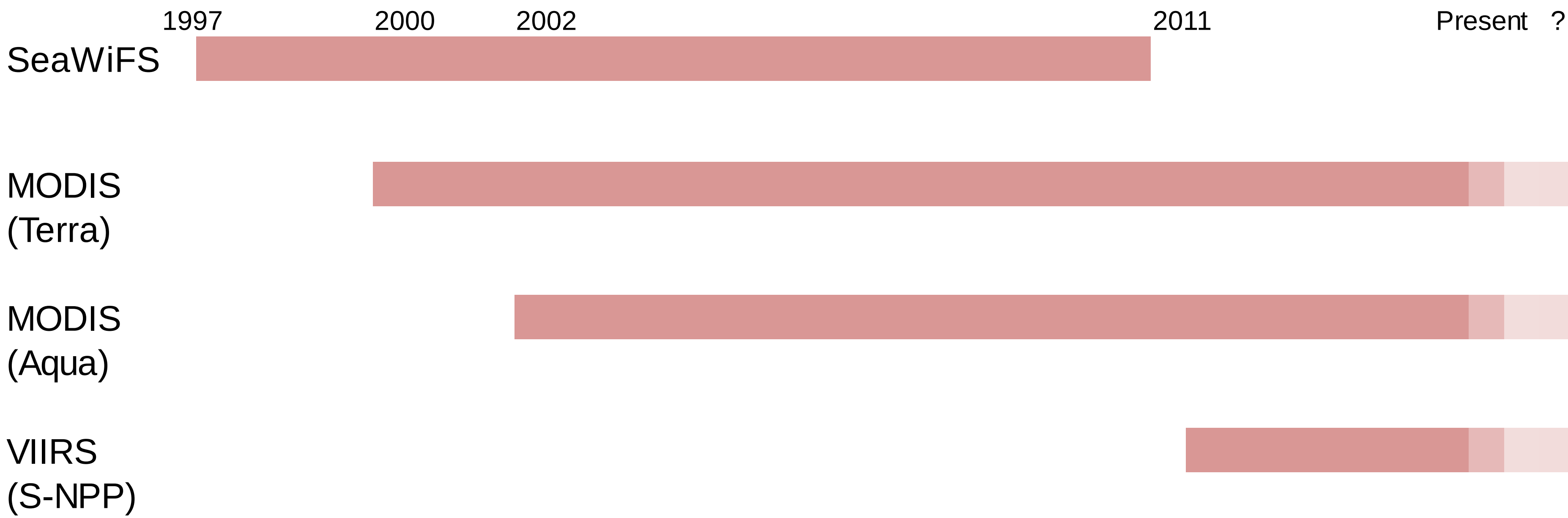
Source: doi:10.1002/2015JD023313

SAYER

The Deep Blue aerosol project: MODIS and VIIRS status

A. M. Sayer[1,2], N. C. Hsu (project PI)[1], C. Bettenhausen[1,3], J. Lee[1,4], N. Carletta[1,3]

[1]NASA GSFC, Greenbelt, MD USA [2]USRA, Columbia, MD USA [3]SSAI, Lanham, MD USA [4]ESSIC, UMCP, MD USA



Questions? Visit deepblue.gsfc.nasa.gov or email andrew.sayer@nasa.gov

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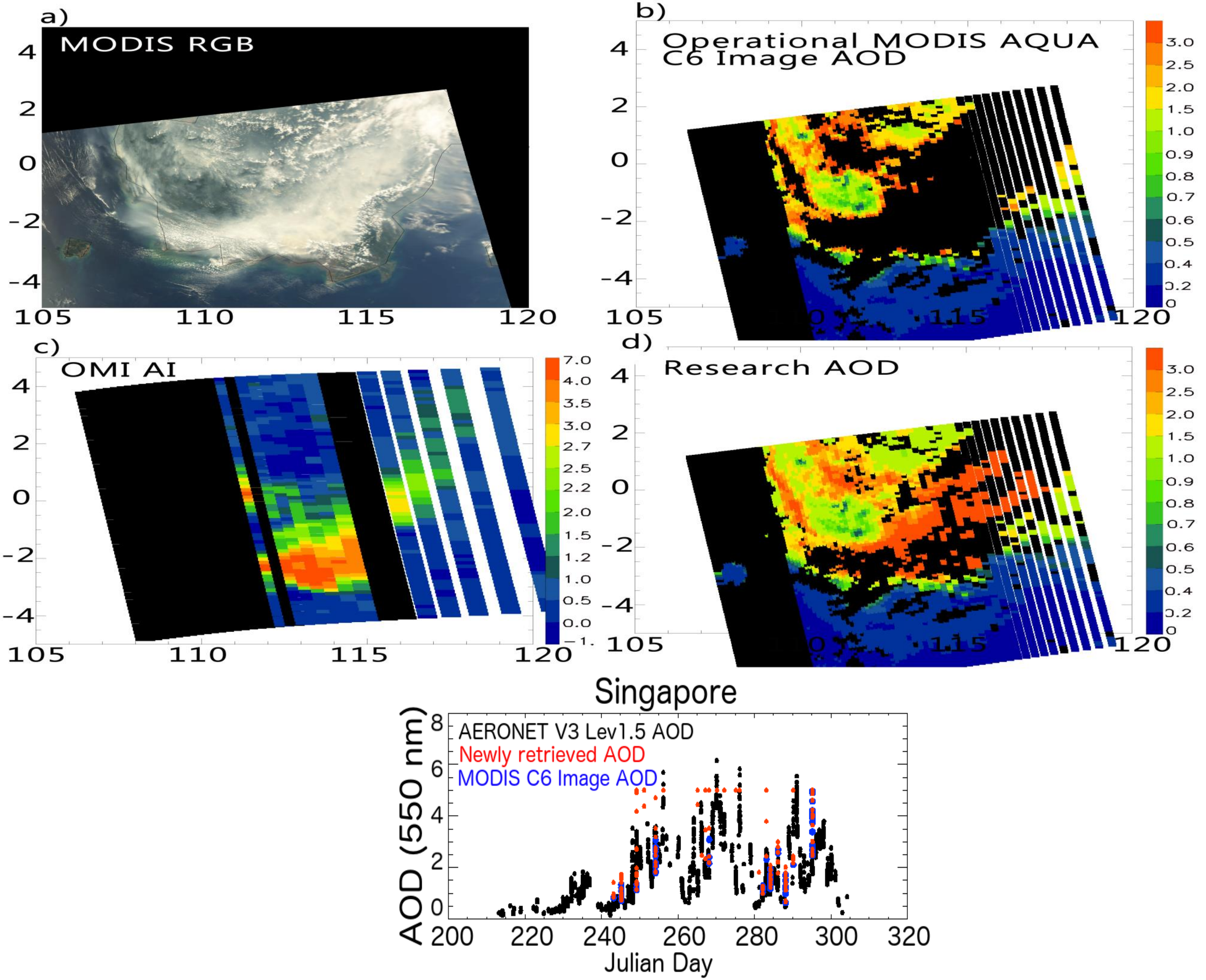
SHI

Constructing an event-based aerosol product under high aerosol loading conditions P-1-37

Yingxi Shi, Robert Levy, Shana Mattoo, Lorraine Remer, Jianglong Zhang

- **High aerosol load** events pose large impacts on the regional environment. It is a great challenge to identify and retrieve AOD over these events from passive sensors.
- In this study, we developed **a research algorithm with relaxed cloud mask** to identify and retrieve optically thick smoke plumes over Southeast Asia, Aug – Oct 2015. (next slide)
- Using MODIS cloud product and **AERONET** data, we **evaluated** research **AOD** product. Compared with the C6 DT product, the research product provides wider data coverage over intense smoke events.
- The regional aerosol climatology is altered by the increasing number of high AOD retrievals.


a)
MODIS RGB
b)
Operational MODIS AQUA C6 Image AOD
c)
OMI AI
d)
Research AOD
Singapore
AERONET V3 Lev1.5 AOD
Newly retrieved AOD
MODIS C6 Image AOD
AOD (550 nm)
Julian Day

STANELLE

Aerosol component of the global climate-aerosol-chemistry model ECHAM6-HAMMOZ: **ECHAM6-HAM2**

Tanja Stanelle et al.

ECHAM 6.3
- Update radiation scheme*1
- Update JSBACH*1
- Atmos. physics conserve energy*1

Wind, T, precip, ... →

← Aerosol Conc.

Wind, rad, T, lai, PFTs, sm ↓

HAM 2.3
- Abdul-Razzak&Ghan activation scheme*3
- Explicit condensation after Levkov et al. (1992)*4
- New sticking efficiency for accretion of ice crystals by snow*5

Natural emissions
regional dust emissions
- Updated MEGAN module*2

Anthropogenic emissions (e.g. **HTAP**)

SO4 EMEP vs model

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95% - Anet (dAOD)

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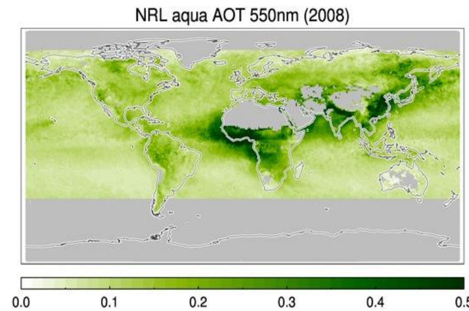
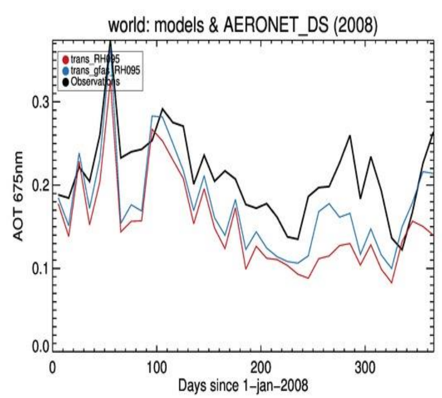
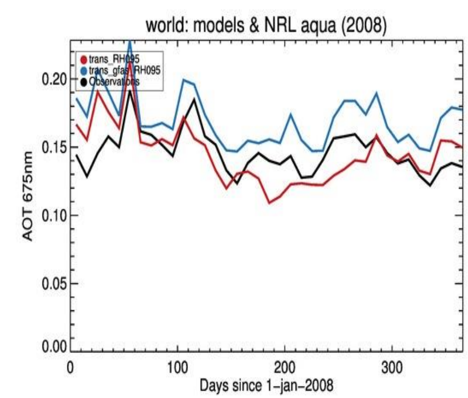
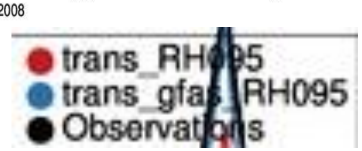
Aqua AOD 2008









STANELLE

DACCIWA

Poster P-1-39

ETH zürich

Air pollution in Southern West Africa: What do different emission inventories tell us?

Tanja Stanelle, Isabelle Bey, Ulrike Lohmann, David Neubauer

Road in the 5-million megalopolis of Abidjan, Ivory Coast. (Photo: Sekou Keita)

Performed simulations with aerosol-climate model **ECHAM6-HAM2**

	Anthro. emissions	**Biomass burning emissions**
ACCMIP	ACCMIP-RCP4.5	ACCMIP-RCP4.5
ACCMIP + gfas	ACCMIP-RCP4.5	gfas
HTAP + gfas	HTAP	gfas

Impact on aerosol distribution and meteorology is discussed

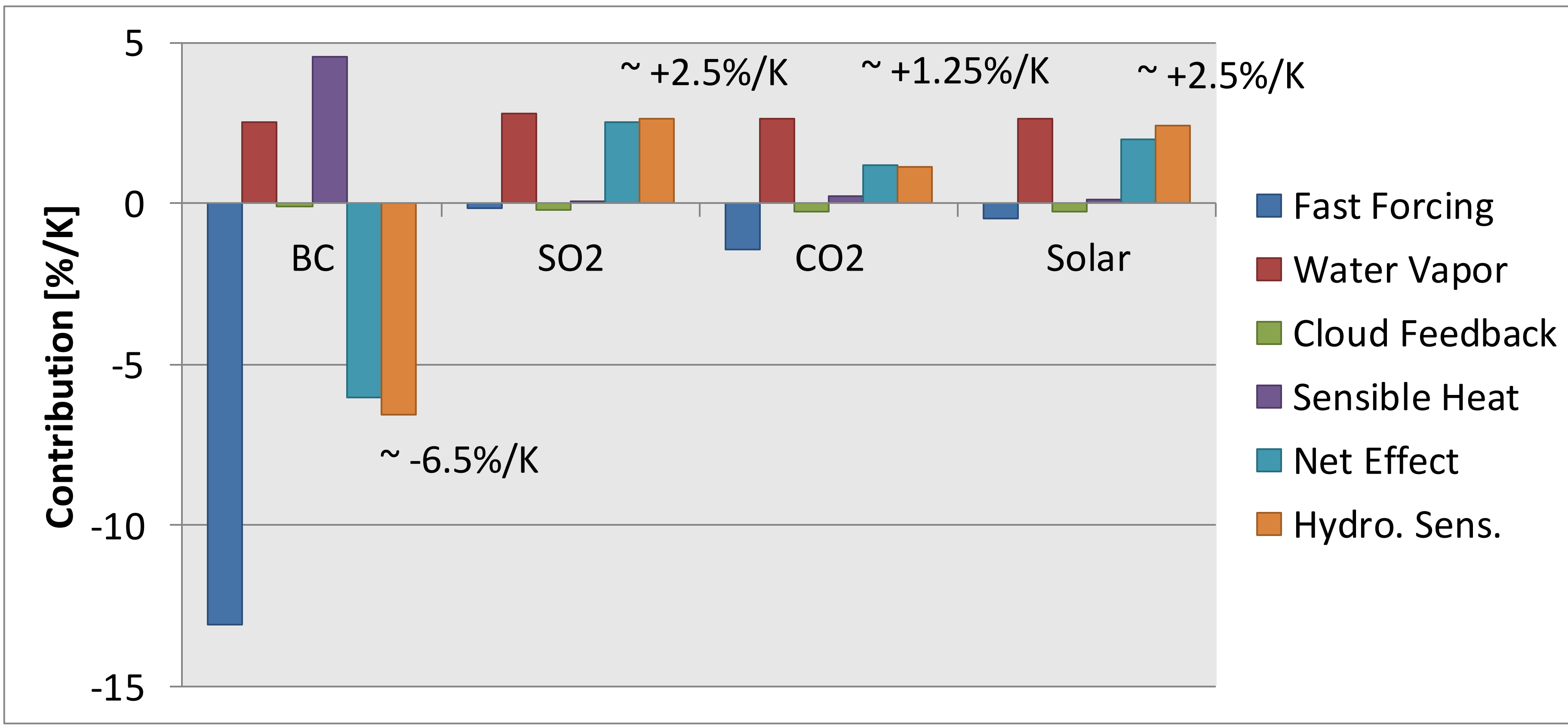
SUZUKI

Energy budget analysis of scattering and absorbing aerosol effects on global precipitation with a global aerosol-climate model

P-1-40

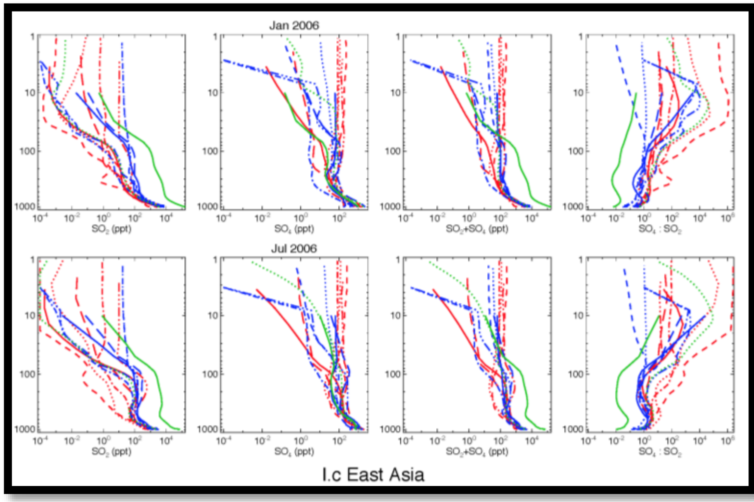
Kentaroh Suzuki (U. Tokyo) and Toshihiko Takemura (Kyushu U.)

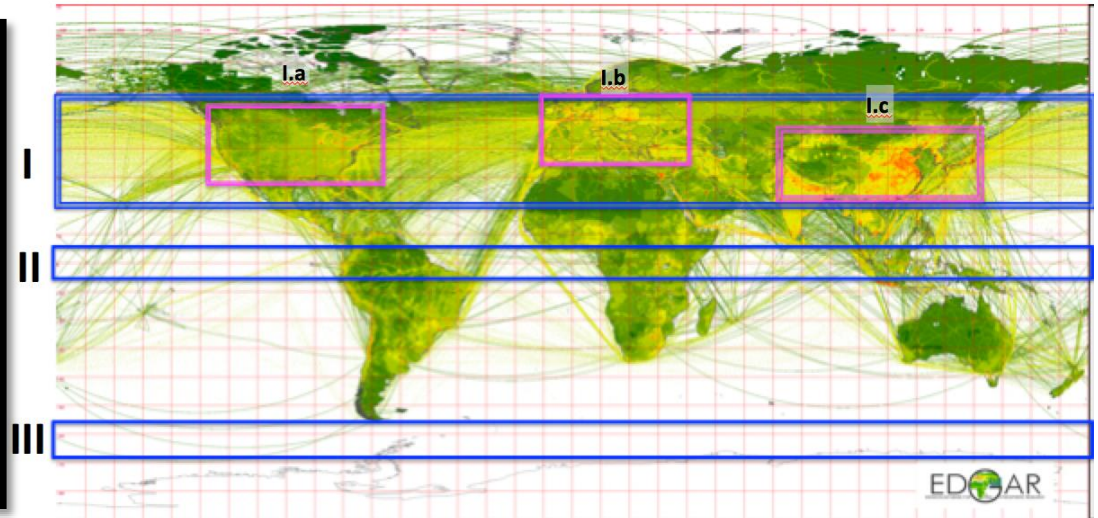
- Energy balance control on global-mean precipitation change
- Influences of water vapor, clouds and aerosols
- Aerosol effects on the hydrologic sensitivity
- Different pathways of scattering/absorbing aerosol effects on precipitation



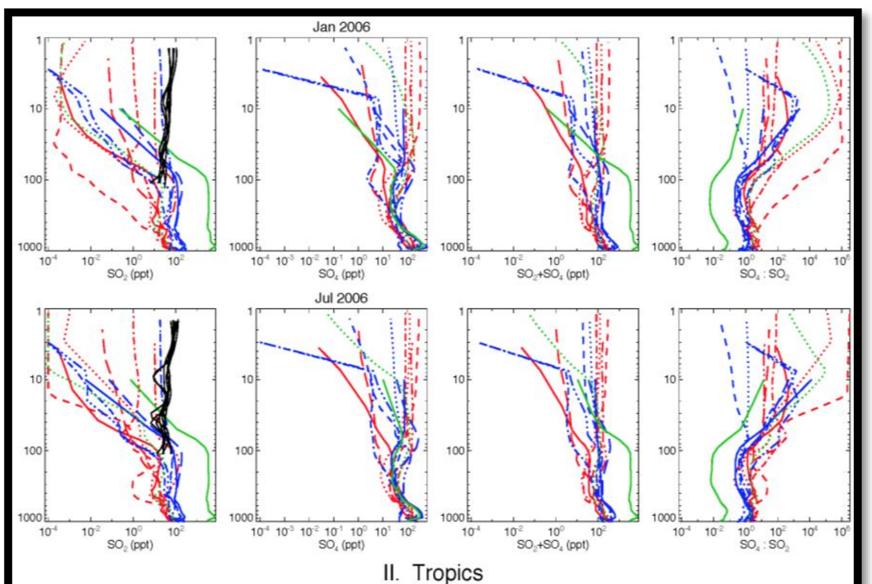
TAN

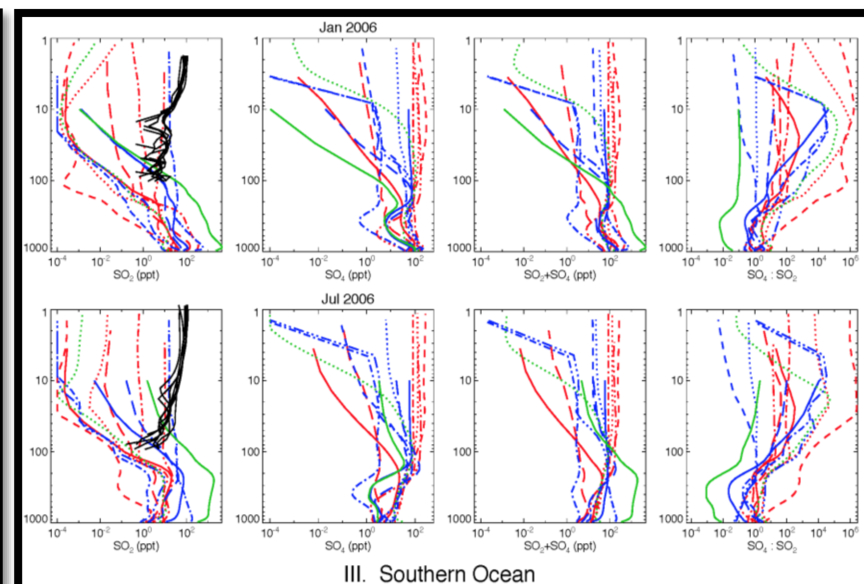
Vertical Profiles of Sulfur Species in AeroCOM-II Models *Q.Tan*





Model divergence increases with altitude and distance away from the source regions.
SO_4:SO_2 ratio suggests large difference in SO_2 oxidation and SO_2/SO_4 removal simulations.





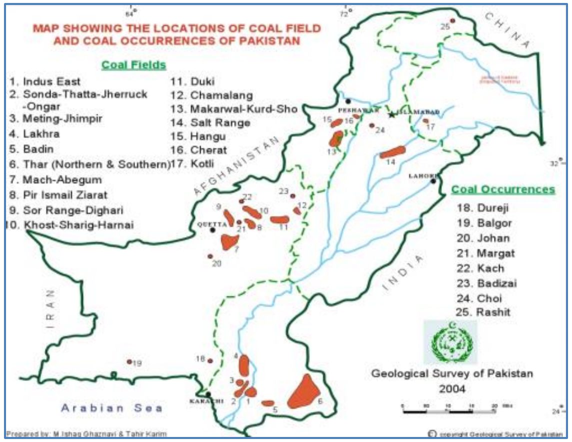
TARIQ

Effects of Anthropogenic Methane Aerosols on Climate of Pakistan

Shahina TARIQ[1], Sunbal SIDDIQUE[2] and Irfan MAHMMOD[3]
Department of Meteorology, COMSATS Institute of information technology, Islamabad, Pakistan
shahinatariq@comsats.edu.pk

Purpose

- To assess methane aerosol effect on climate by identifying the release of methane aerosols into the atmosphere
- Manipulating the climate by studying spatial distribution of climatic variables during the time series of 1952-2015 in Sindh Region, Pakistan.



Indigenous Coal Fields in Pakistan

Table 1. Pakistan's Coal Reserves and Production

Indicator	Anthracite & Sub-bituminous (million tonnes)	sub Bituminous & Lignite (million tonnes)	Total (million tonnes)	Global Rank (# and %)
Estimated Proved Coal Reserves (2011)	0	2,070	2,070	21 (0.2%)
Annual Coal Production (2012)	1.9	1.2	3.1	38(0.04%)

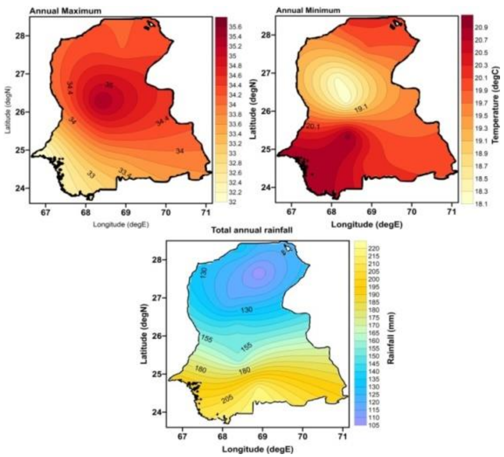
Source: EIA (2014)

Environmental Challenges

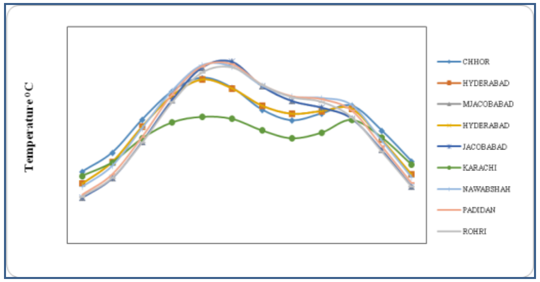
Pakistan Environmental Protection Agency has established the National Environmental Quality Standards (NEQS) relating to Industrial Gaseous Emission and Liquid Industrial Effluents. Power plants using oil or coal as fuel will comply with the NEQS

Results and Discussions

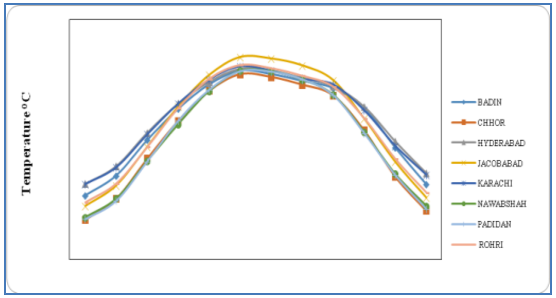
Spatial distribution climatic variables (1952-2015) in Sindh Province.



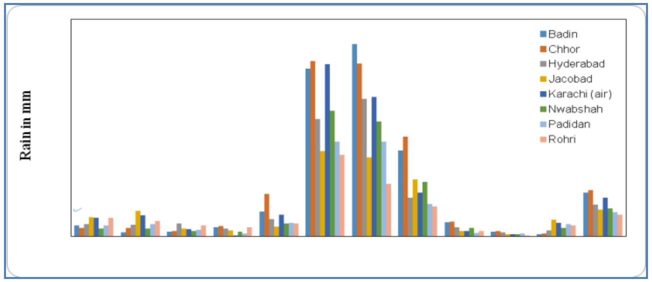
Spatial distribution climatic variables



Mean monthly maximum temperature °C



Mean monthly minimum temperature °C



Mean monthly Rainfall

Table 2 Pakistan's CMM Emissions (million cubic meters)

Emissions	2000	2005	2010	2015	2030
Total CH4 Emitted	66.5	105.0	79.1	86.8	119

Source: US EPA (2012)

Conclusion

- Amount of methane in atmosphere has increased from 66.5 CMM (million cubic meters) in the year 2000 to 86.8 CMM in the year 2015.
- Future projections results predict that amount of methane will increase to 119 (CMM) by 2030 and will cause more floods and hence increase in Sea level.

Recommendation

- Suggested to carry out systematic studies of the industrial pollutants in relation to the increasing requirements of power generation to control the atmospheric pollutants and to save the country from extreme weather events.

Reference: Pakistan Coal power Generation Potential, Private Power and Infrastructure Board, Ministry of Water and Power Government of Pakistan, 2004, pp 9-11
Baqri,S.R.H.(2014).International coal conference,University of Pittsberg,Pittsberg,U.S.A.

TITOS

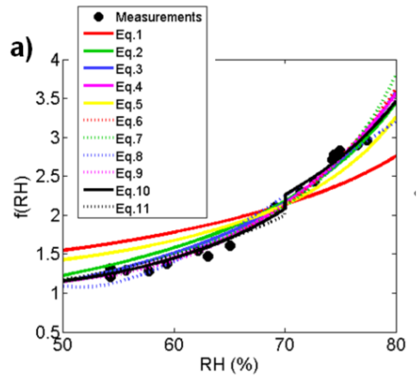
A review of the effect of hygroscopic growth on the aerosol light-scattering coefficient

Gloria TITOS[1], Paul ZIEGER[2] and Betsy ANDREWS[3]

[1]Institute of Environmental Assessment and Water Research (IDAEA), CSIC, Barcelona, 08034, Spain
[2]Stockholm University, Stockholm, Sweden
[3]National Oceanic and Atmospheric Administration (NOAA), Boulder, USA

Aerosol particles can take up water → modifying aerosol optical properties and direct aerosol radiative forcing.

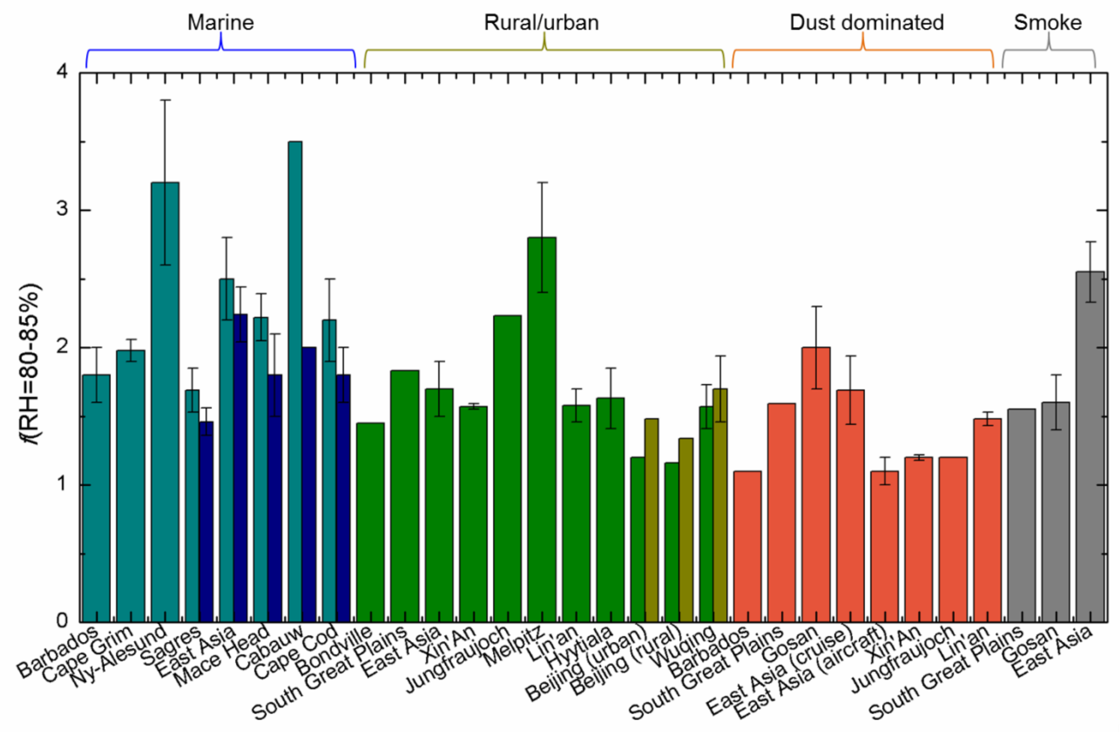
The RH dependence of the aerosol light-scattering can be quantified by the scattering enhancement factor, *f*(RH).



Precise *f*(RH) measurements are needed for validation of model outputs. In this poster presentation we:

- Provide a review of *f*(RH) measurements performed over the past 50 years.
- Quantify the overall measurement uncertainty in *f*(RH) to be around 20-40% for moderately hygroscopic aerosols.

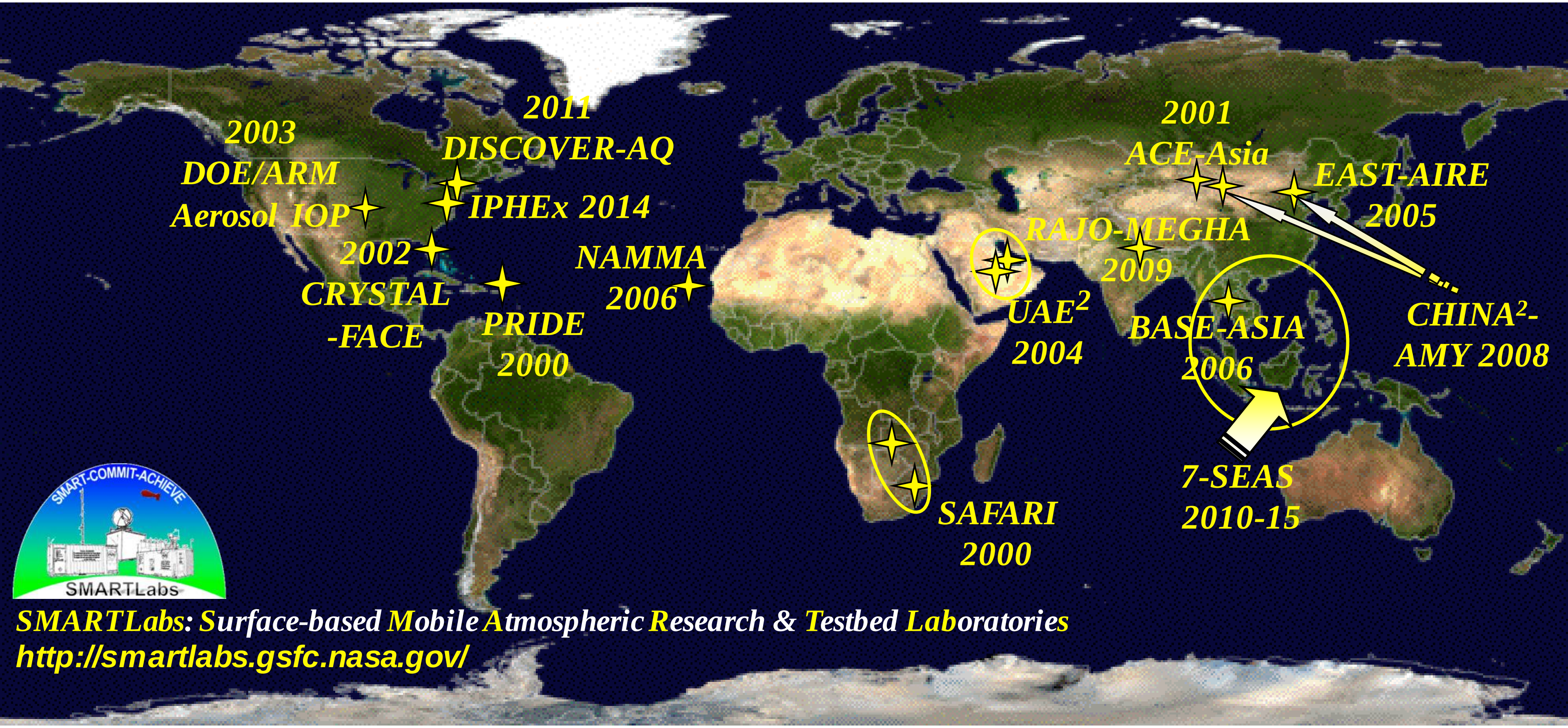
LITERATURE REVIEW OF AMBIENT MEASUREMENTS



- Large variability in *f*(RH) across sites and aerosol types.
- Clean, marine environments highest *f*(RH) → pollution typically decreased the *f*(RH) of marine aerosol.
- Dust aerosol lowest reported hygroscopicity of any of aerosol types.
- Comparison is not straightforward → differences in the instrumentation, methodology and associated uncertainties.

TSAY

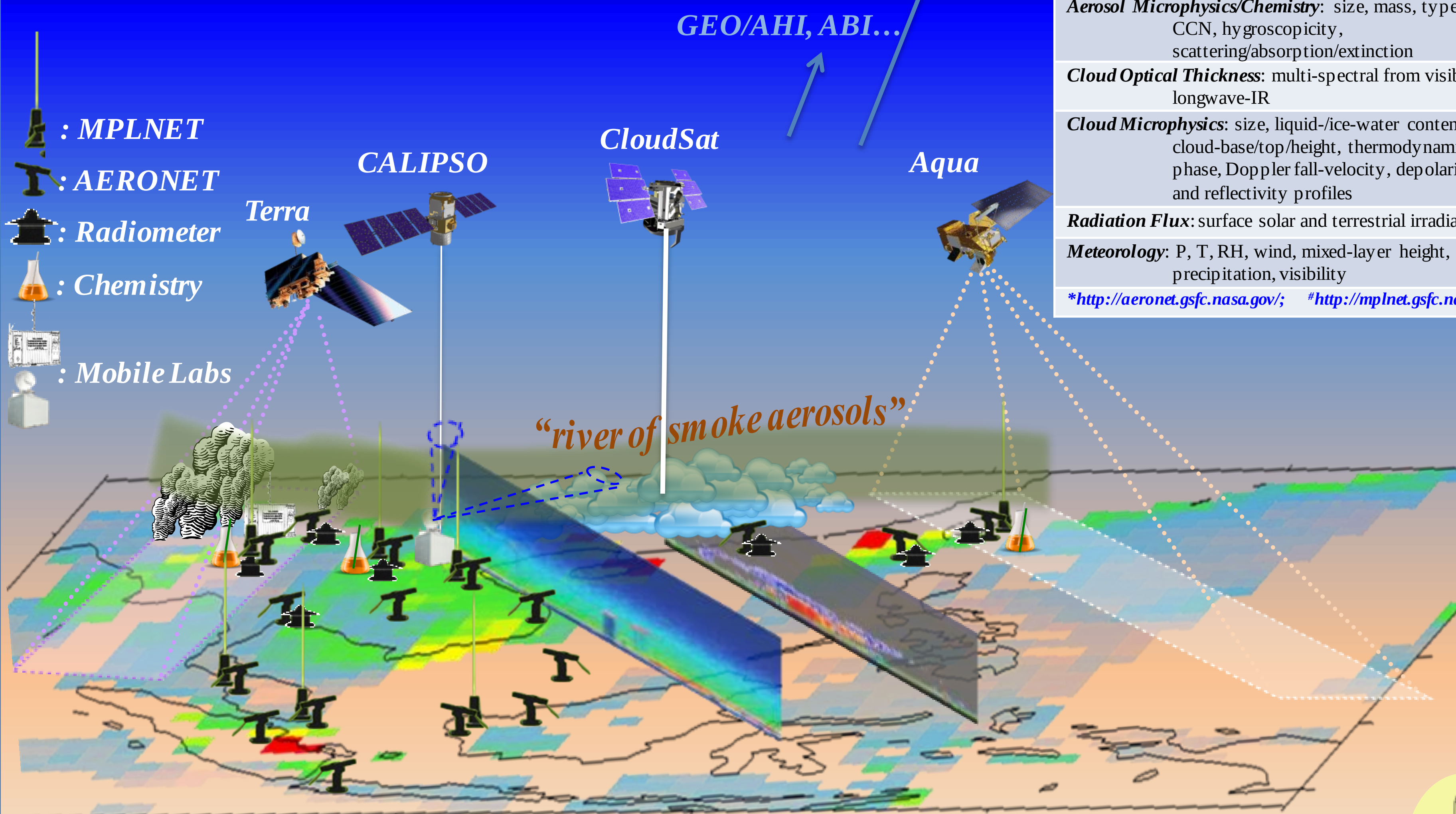
7-SEAS/BASELInE: Satellite-surface perspective of air quality and aerosol-cloud effects on the environment



- *Small Operations (3-4 operators/scientists), yet Cost-Effective: over 10 countries on 3 continents for aerosol-cloud-radiation studies*
- *Achievements: >80 SMARTLabs publications since 2000 & many in process for the spring 2010-2015 7-SEAS deployments*
- *Future Missions: Cal/Val for S-NPP, GPM, …, and EV deployments*

SMARTLabs Operation: Strategies & Products

SMARTLabs/AERONET*/MPLNET#
Trace Gas – Column: O_3, NO_2, SO_2, HCHO, CO, H_2O; – ***Surface***: CO, CO_2, O_3, SO_2, NO, NOx/NOy; – ***Profile***: NO_2, (O_3 in progress)
Aerosol Optical Thickness: multi-spectral from UV to shortwave-IR, dust at longwave-IR, and extinction profile
Aerosol Microphysics/Chemistry: size, mass, type, CCN, hygroscopicity, scattering/absorption/extinction
Cloud Optical Thickness: multi-spectral from visible to longwave-IR
Cloud Microphysics: size, liquid-/ice-water content, cloud-base/top/height, thermodynamic phase, Doppler fall-velocity, depolarization and reflectivity profiles
Radiation Flux: surface solar and terrestrial irradiance
Meteorology: P, T, RH, wind, mixed-layer height, precipitation, visibility
**http://aeronet.gsfc.nasa.gov/; #http://mplnet.gsfc.nasa.gov/*



Lagrange-like: for transport and evolution of the pollutants
DRAGON-like (Distributed Regional Aerosol Gridded Observation Networks): for statistical comparisons

Si-Chee Tsay, Deputy
EOS/Terra Project Scientist

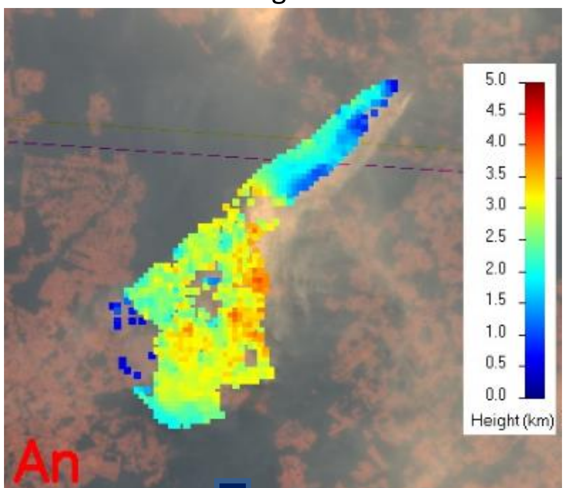
September 19, 2016
NASA/GSFC

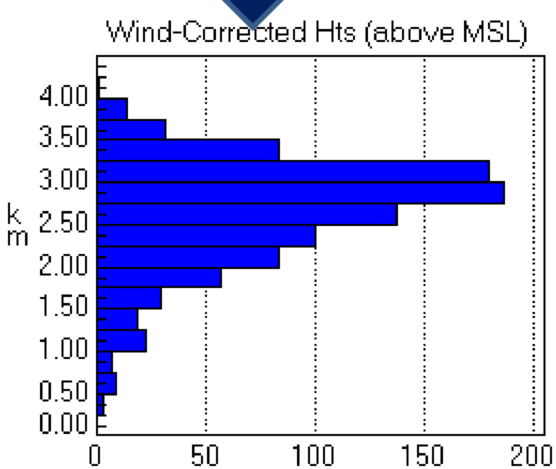
VAL MARTIN

Biomass Burning Experiment PHASE 2: Fire Emission Injection Heights

Maria Val Martin, Ralph Kahn, Mian Chin, Mariya Petrenko

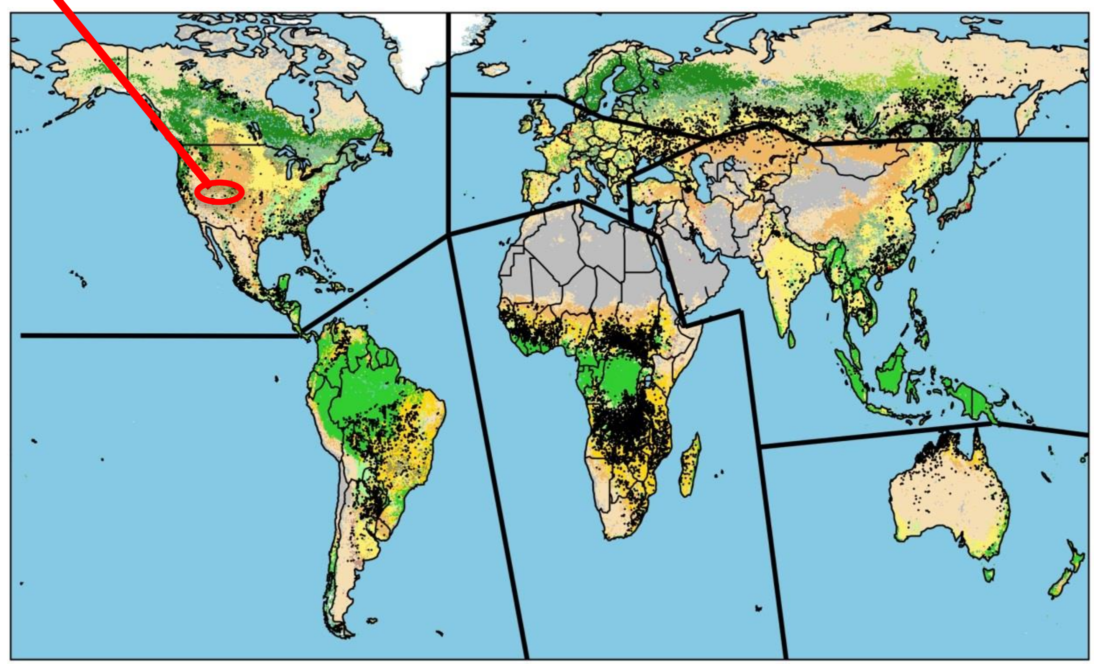
Nadir Image w/ Color-Coded, Wind-Corrected Heights





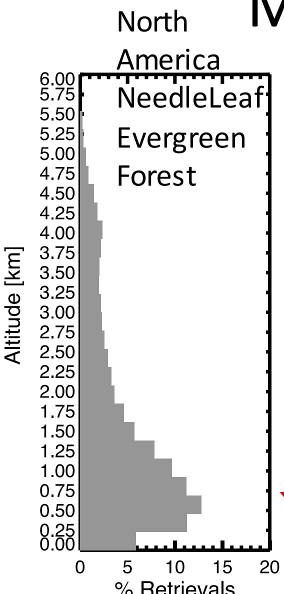
About 16,000 smoke plumes were digitized with MINX for 2008.

Each plume was operator-processed using MINXv4 and quality controlled.



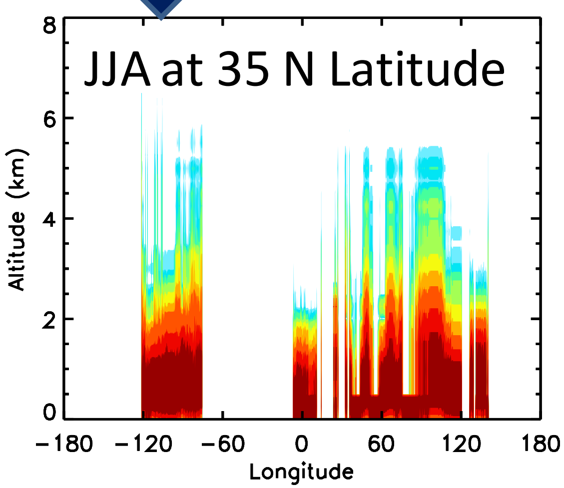
Biomass Burning Experiment PHASE 2: Fire Emission Injection Heights

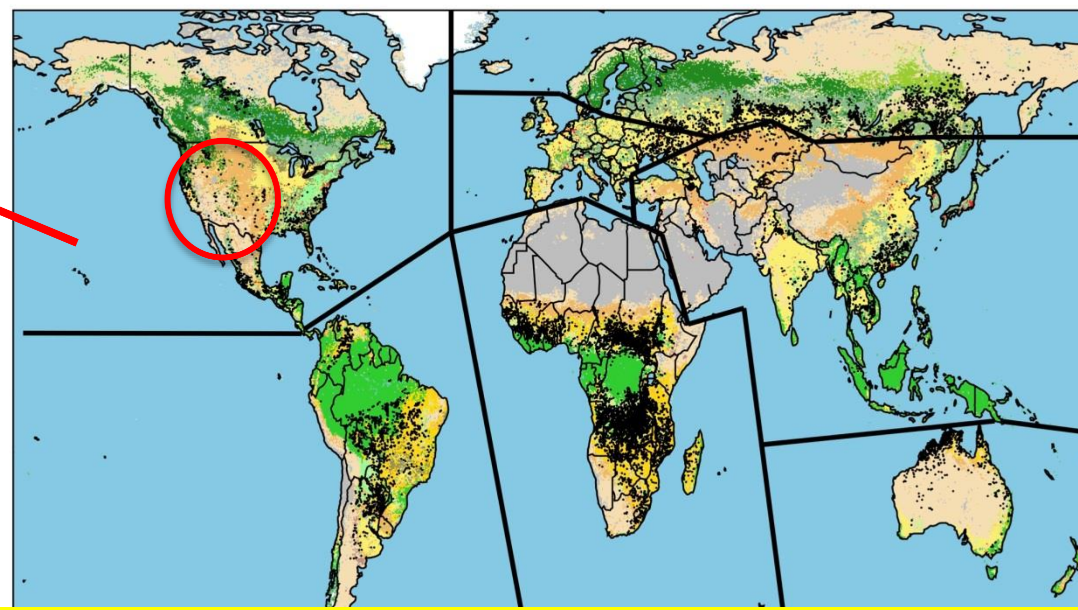
Maria Val Martin, Ralph Kahn, Mian Chin, Mariya Petrenko



We developed a parameterization with fire emission fractions by altitude, region, ecosystem and season from statistical summaries of worldwide MISR plume height observations

We invite AeroCom participants to run their models with these injection-height constraints





More information in poster by Maria Val Martin

WANG q

Impact of anthropogenic aerosols from global, East Asian, and non-East Asian sources **on East Asian summer monsoon system**

Qiuyan Wang[a,b], Zhili Wang[b,a,*], Hua Zhang[c,a]

[a] Collaborative Innovation Center on Forecast and Evaluation of Meteorological Disasters, Nanjing University of Information Science and Technology, Nanjing, China

[b] State Key Laboratory of Severe Weather & Key Laboratory of Atmospheric Chemistry of CMA, Chinese Academy of Meteorological Sciences, Beijing, China

[c] Laboratory for Climate Studies, National Climate Center, China Meteorological Administration, Beijing, China

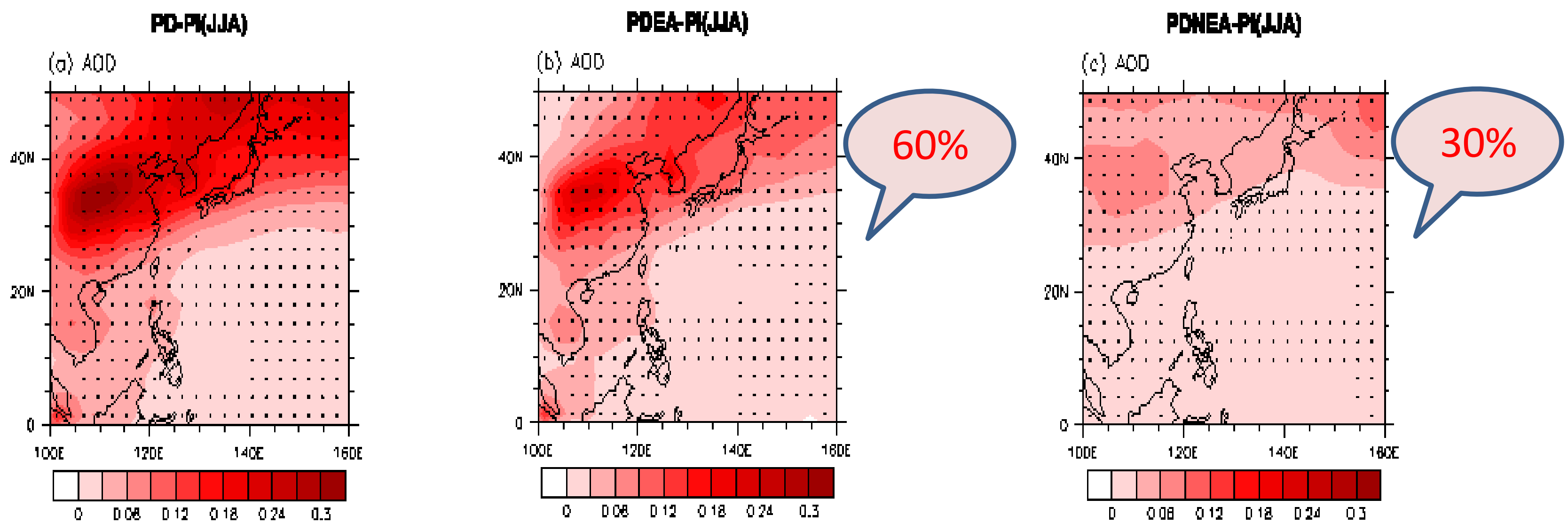


Fig.1 JJA mean changes in **AOD (unitless) at wavelength of 550 nm** over the EAMR due to the changes in anthropogenic aerosol emissions

globe **East Asia** **non-East Asia**

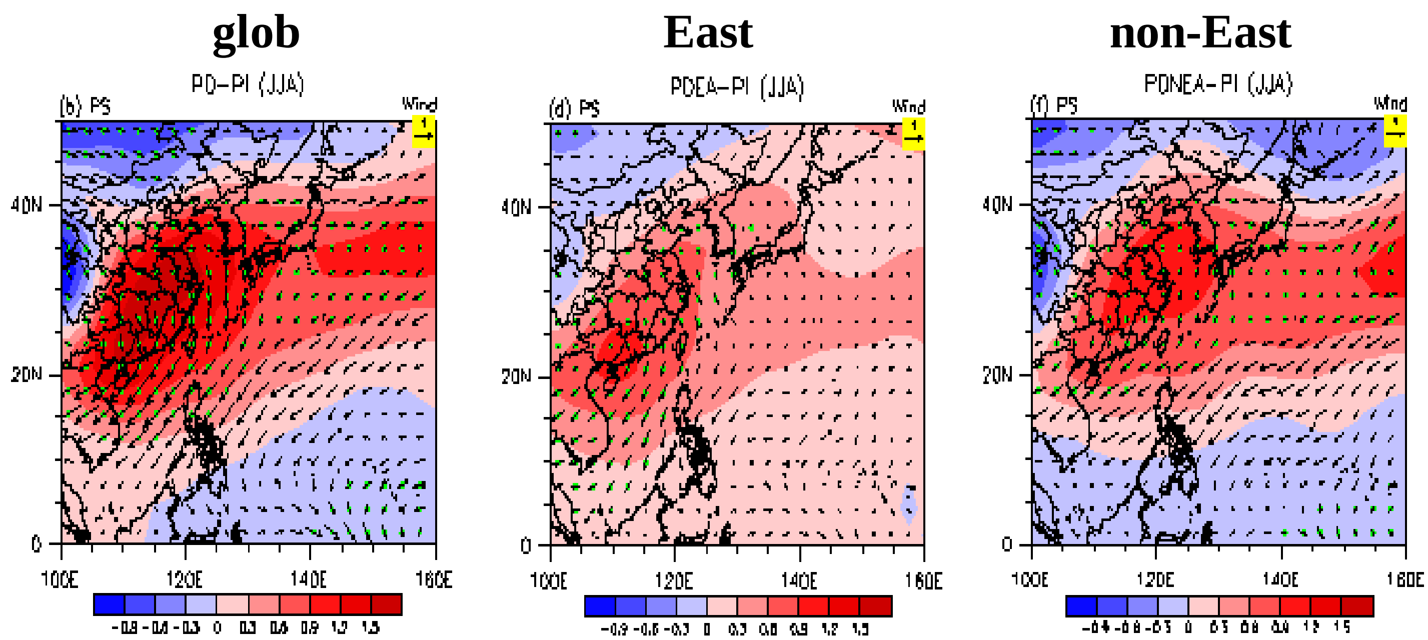


Fig.2 JJA mean changes in (b, d, f) **surface pressure (unit: hPa) overlapped with surface wind vectors (m s^{-1})** over the EAMR due to the changes in anthropogenic aerosols. (b) PD - PI, (d) PDEA - PI, and (f) PDNEA - PI. The dots represent significance at ≥ 95% confidence level from the t-test.

Table 1 The EASM indices from different simulations. This index is defined by the U_{850} in (5°–15°N, 100°–130°E) minus U_{850} in (20°–30°N, 110°–140°E), where U_{850} denotes the zonal wind at 850 hPa (Wang and Fan, 1999).

	PI	PD	PDEA	PDNEA
EASM index	12.50	11.30	11.72	11.61

WANG z

Sensitivity of precipitation extremes to radiative forcing of greenhouse gases and aerosols

Zhili Wang[1], Lei Lin[2], Yangyang Xu[3], Qiang Fu[4]

[1] Chinese Academy of Meteorological Sciences, Beijing, China
[2] Department of Atmospheric Sciences, Sun Yat-sen University, Guangzhou, Guangdong, China
[3] Department of Atmospheric Sciences, Texas A&M University, College Station, Texas, USA
[4] Department of Atmospheric Sciences, University of Washington, Seattle, Washington, USA

- **Greenhouse gases (GHGs) and aerosols will continue to be the two most important anthropogenic forcing agents in the 21st century. The expected declines of aerosols in the 21st century from present-day levels would impose an additional warming on the Earth (*IPCC AR5*), which will aggravate the climate extremes caused by GHG-induced warming (*Sillmann et al. 2013; Wang et al. 2016*).**

- **We examined the rate of increase in precipitation extremes with global mean surface warming caused by anthropogenic GHGs and aerosols in the 21st century using the Community Earth System Model (CESM1) ensemble simulations.**

Aerosol forcing leads to a larger increased rate than GHG forcing by a factor of 2 to 4 for various precipitation extremes indices

Figure 1. Scatterplot of changes in land-averaged (a) precipitation and (b) - (f) precipitation extremes (*y*-axis) versus global mean surface temperature changes (*x*-axis) because of GHG, aerosol (AER), and GHG & AER forcings from RCP8.5.

Table 1. The Rates of Changes in Land-averaged Precipitation (P) and Precipitation Extremes with Global Mean Surface Temperature Increase Caused by GHG and Aerosol (AER) Forcing From RCP8.5 and their Ratios. The values in parentheses are 2 standard deviations.

	Land		
	AER (% °C^{-1})	GHG (% °C^{-1})	Ratio (AER/GHG)
P	7.3 (4.42)	1.8 (0.73)	4.0 (4.09)
RX1day_Annual	13.2 (7.80)	6.1 (0.94)	2.2 (1.55)
RX1day	9.4 (6.65)	3.9 (0.88)	2.4 (2.22)
RX5day	8.4 (5.72)	2.9 (0.84)	2.9 (2.97)
R95p	8.4 (5.65)	2.3 (0.84)	3.7 (4.22)
R10	8.8 (6.02)	2.5 (1.02)	3.5 (4.17)

please visit my poster

ZHANG

Model analysis of soil dust impacts on the boundary layer meteorology and air quality over East Asia in April 2015

Lei Chen[a,b], Meigen Zhang[a,*], Jia Zhu[a,b], Andrei Skorokhod[c]

P-1-52

- ✓ Soil dust is a nonnegligible air pollutant in the atmosphere, and it remarkably affects solar radiations, meteorological variables, and heterogeneous chemical reactions.
- ✓ East Asia is one of the most prominent dust emission regions in the world and a severe dust storm occurred from 14 to 17 April 2015.
- ✓ WRF-Chem model is used to estimate the impacts of dust aerosols on
  - Radiative forcing
  - Boundary layer meteorology
  - Pollutant concentrations

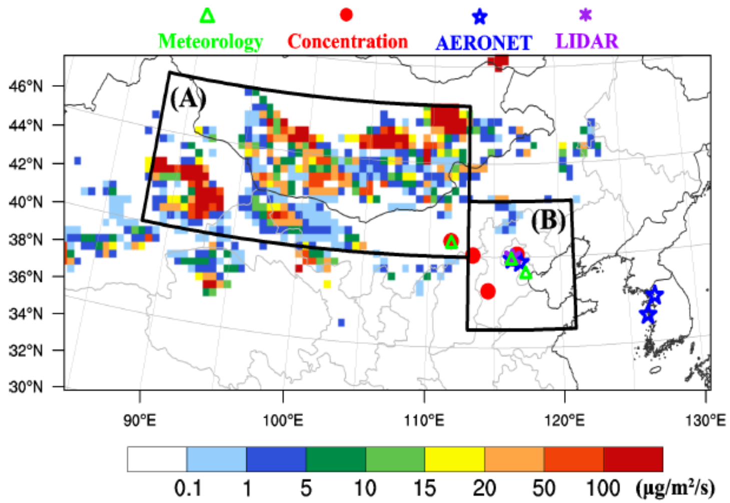


Fig.1.Analyzed domain and spatial distribution of dust emissions over East Asia. (A: dust source areas, B: North China Plain)

Reactions	Uptake coefficients	Reaction Ref
O_3 + Dust = Products	RH–dependence	Zhu et al. (2010)
HNO_3 + Dust = $0.5NO_x$ + Products	RH–dependence	Kumar et al. (2014)
OH + Dust = $0.05H_2O_2$ + Products	RH–dependence	Kumar et al. (2014)
HO_2 + Dust = $0.1H_2O_2$ + Products	RH–dependence	Kumar et al. (2014)
H_2O_2 + Dust = Products	2.00E-03	Pradhan et al. (2010)
NO_2 + Dust = 0.5HONO + $0.5HNO_3$	2.10E-06	Zhu et al. (2010)
NO_3 + Dust = HNO_3	0.1	Martin et al. (2003)
N_2O_5 + Dust = $2HNO_3$	0.03	Zhu et al. (2010)
SO_2 + Dust = H_2SO_4	RH–dependence	Zheng et al. (2015)

Table 1. Uptake coefficients for heterogeneous reactions on dust surfaces

Experiments	Dust	Heterogeneous Chemical reactions
CTL	On	On
NoD_NoH	Off	Off
D_NoH	On	Off

Table 2. Experimental design

ZHAI

Detecting critical $PM_{2.5}$ emission sources and their contributions to a heavy haze episode in Beijing, China by using an adjoint model

Shixian Zhai, Xingqin An, Tianliang Zhao, Zhaobin Sun, Chao Wang

中国气象科学研究院

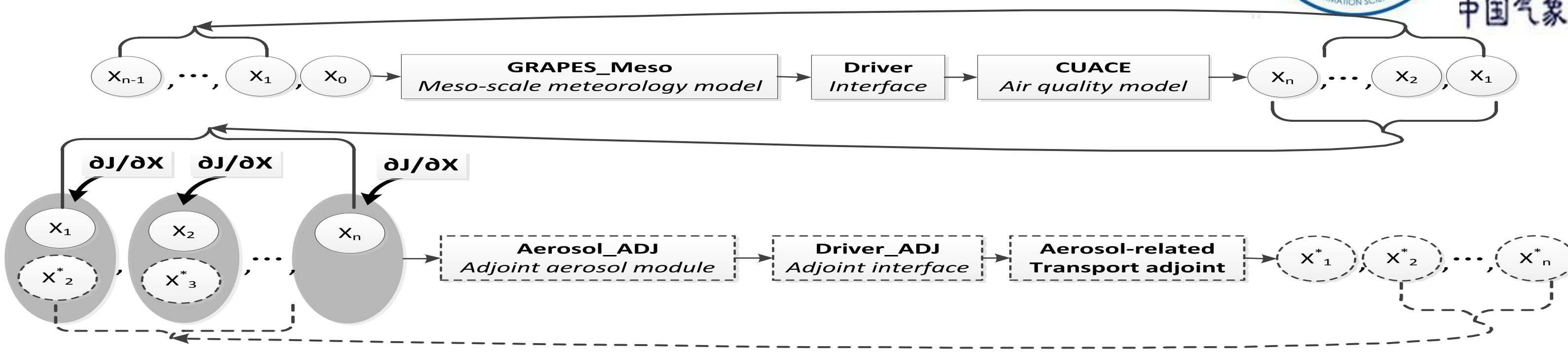
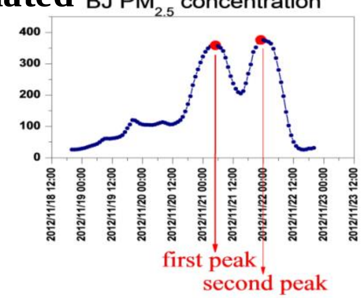


Figure1 Flow chart of GRAPES-CUACE aerosol adjoint model (An et al., 2016)

(Global-Regional Assimilation and Prediction System coupled with CMA Unified Atmospheric Chemistry Environment)

①The GRAPES-CUACE aerosol adjoint model was applied in tracking $PM_{2.5}$ sources.

Simulated BJ $PM_{2.5}$ concentration



Objectives:

To analyze the generating processes of the two hourly $PM_{2.5}$ concentration peaks

To compare adjoint results with Models-3/CMAQ assessments.

Objective functions:

Average Beijing $PM_{2.5}$ concentration:

First & second peaks in Figure 3:
①at 05:00 on Nov. 21st 2012;
②at 23:00 on Nov. 21st 2012;

③on Nov. 21st.

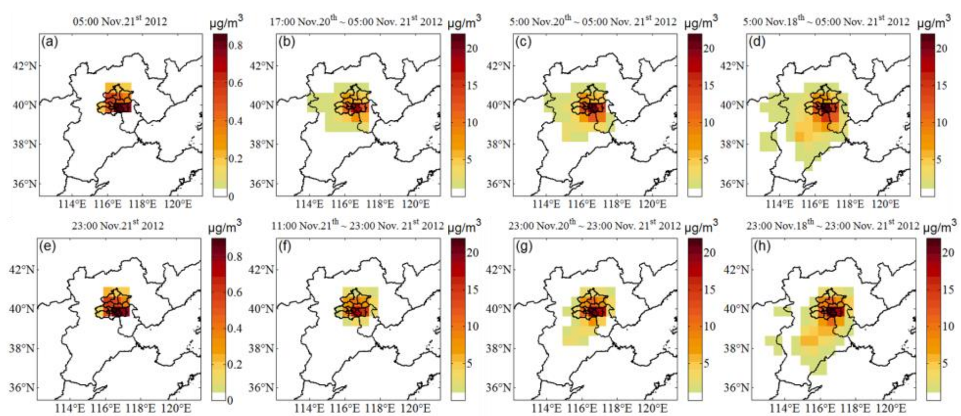


Figure2 Spatial distribution of time accumulated sensitivity coefficients (emissions real contribution) for the first (a-d) and second (e-h) $PM_{2.5}$ concentration peaks.

An X. Q., Zhai S. X., et al. Development of an adjoint model of GRAPES–CUACE and its application in tracking influential haze source areas in north China. Geosci. Model Dev., 2016.

P-1-55

②Response time of Beijing $PM_{2.5}$ pollution peaks to local and surrounding emissions is quantized.

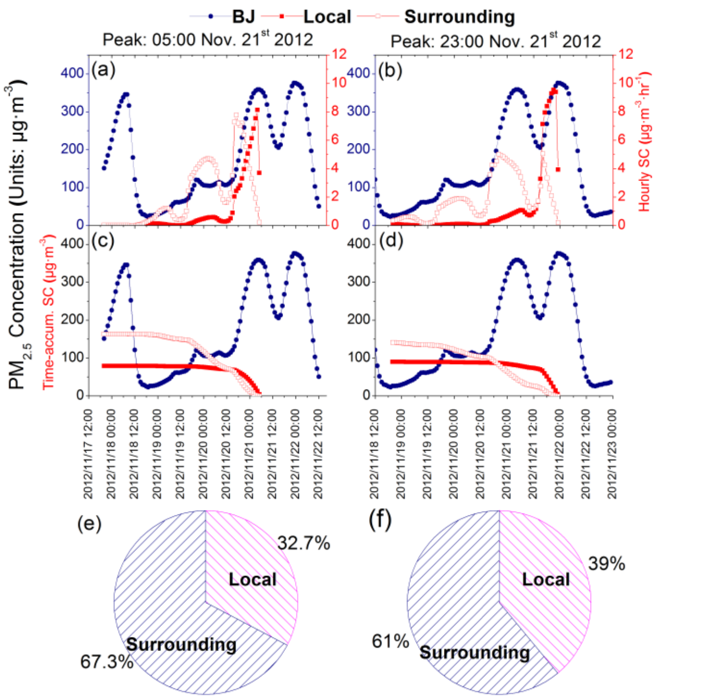
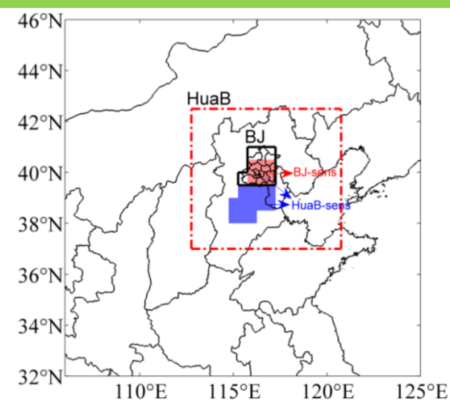


Figure 4 Local and surrounding emission sources contributions to $PM_{2.5}$ concentration peaks on 05:00 (left) and 23:00 Nov. 21st 2012 (right).

(a)-(b): hourly contribution time series;
(c)-(d): time accumulated contribution time series;
(e)-(f): Contribution percentages of local and surrounding primary $PM_{2.5}$ emission sources.

Objective function set as: average $PM_{2.5}$ concentration on Nov. 21st:

③The adjoint results consisted well with Models-3/CMAQ assessments (Zhai et al., 2016) and if of much higher computational efficiency.



Sensitivie area ratio to full regions:
HB-sens/HB=10.2%
BJ-sens/BJ=60%

Fig. 6 Domain definitions of full and sensitive source regions.

Table 1 Contrast of sensitive and full region emissions sources contribution

Time period	Factors	BJ-sens	HuaB-sens
d0	S/F(effect)	86.6%	71.9%
	S/F(efficiency)	1.4	7.0
d1	S/F(effect)	88.2%	64.9%
	S/F(efficiency)	1.5	6.3
d2	S/F(effect)	88.2%	61.0%
	S/F(efficiency)	1.5	6.0

Joint control focused on sensitive emission regions ahead of the predicted peak pollution can efficiently reduce $PM_{2.5}$ concentration in Beijing.

Zhai S. X., An X. Q., et al. Model Assessment of Atmospheric Pollution Control Schemes for Critical Emission Regions, Atmos. Environ., 2016.

ZHOU

The effective radiative forcing of partial internally mixed and externally mixed anthropogenic aerosols and their effects on global climate

Chen Zhou[a,b,c], Hua Zhang[b,c,*] (Email: huazhang@cma.gov.cn), Shuyun Zhao[c], Jiangnan Li[d]

[a] Chinese Academy of Meteorological Sciences

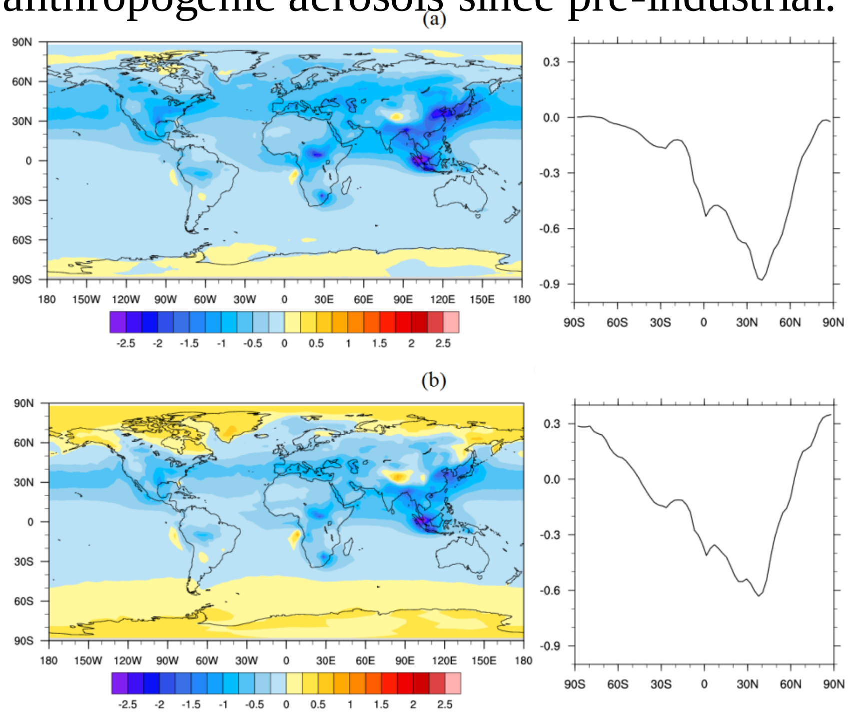
[b] Collaborative Innovation Center on Forecast and Evaluation of Meteorological Disasters，Nanjing University of Information Science & Technology

[c] Laboratory for Climate Studies, National Climate Center, China Meteorological Administration,

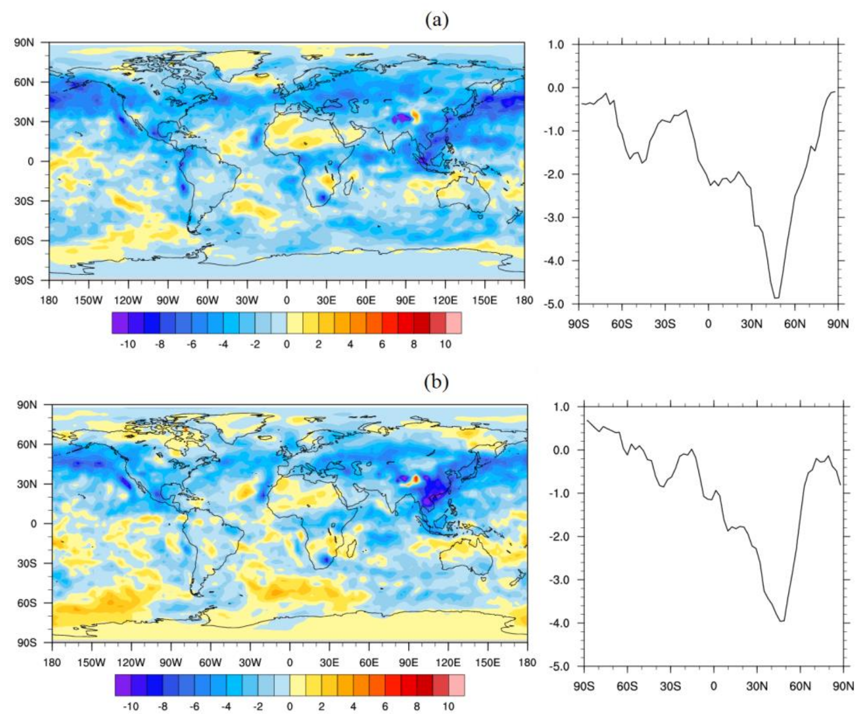
[d] Environment Canada, Victoria, British Columbia

* Corresponding Author at: Laboratory for Climate Studies, National Climate Center, China Meteorological Administration, Beijing, China.

We compared the ERF and climate effects of partial internally mixed and externally mixed anthropogenic aerosols since pre-industrial.



DRF



ERF

The effective radiative forcing of partial internally mixed and externally mixed anthropogenic aerosols and their effects on global climate

Chen Zhou[a,b,c], Hua Zhang[b,c,*] (Email: huazhang@cma.gov.cn), Shuyun Zhao[c], Jiangnan Li[d]

[a] Chinese Academy of Meteorological Sciences

[b] Collaborative Innovation Center on Forecast and Evaluation of Meteorological Disasters，Nanjing University of Information Science & Technology

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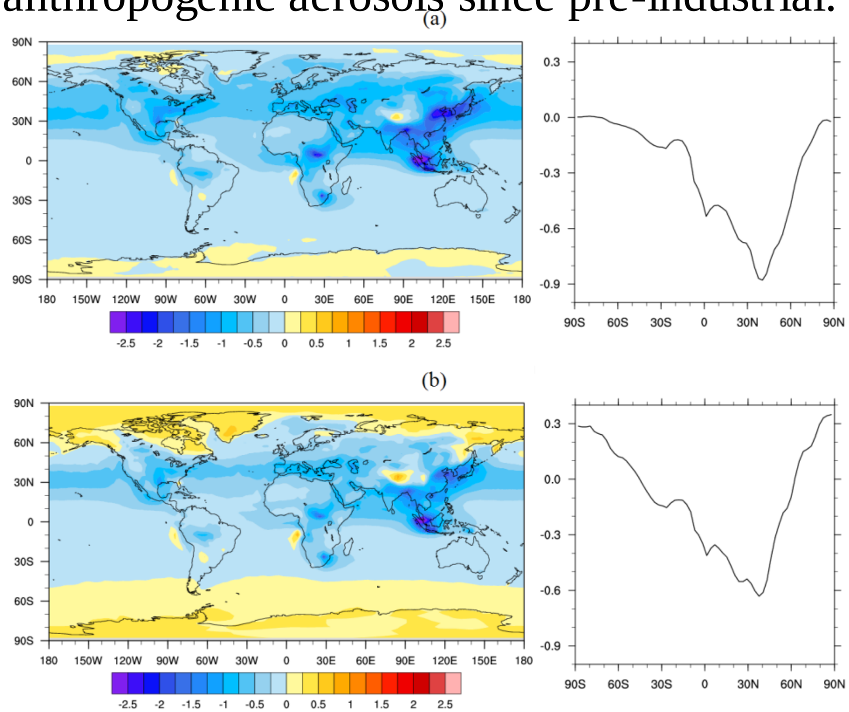
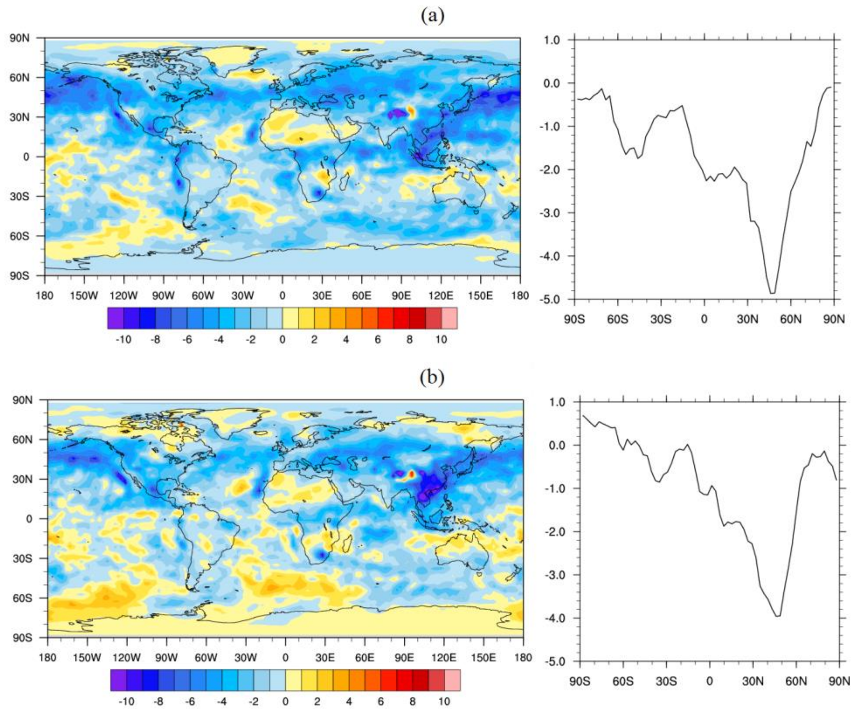


DRF



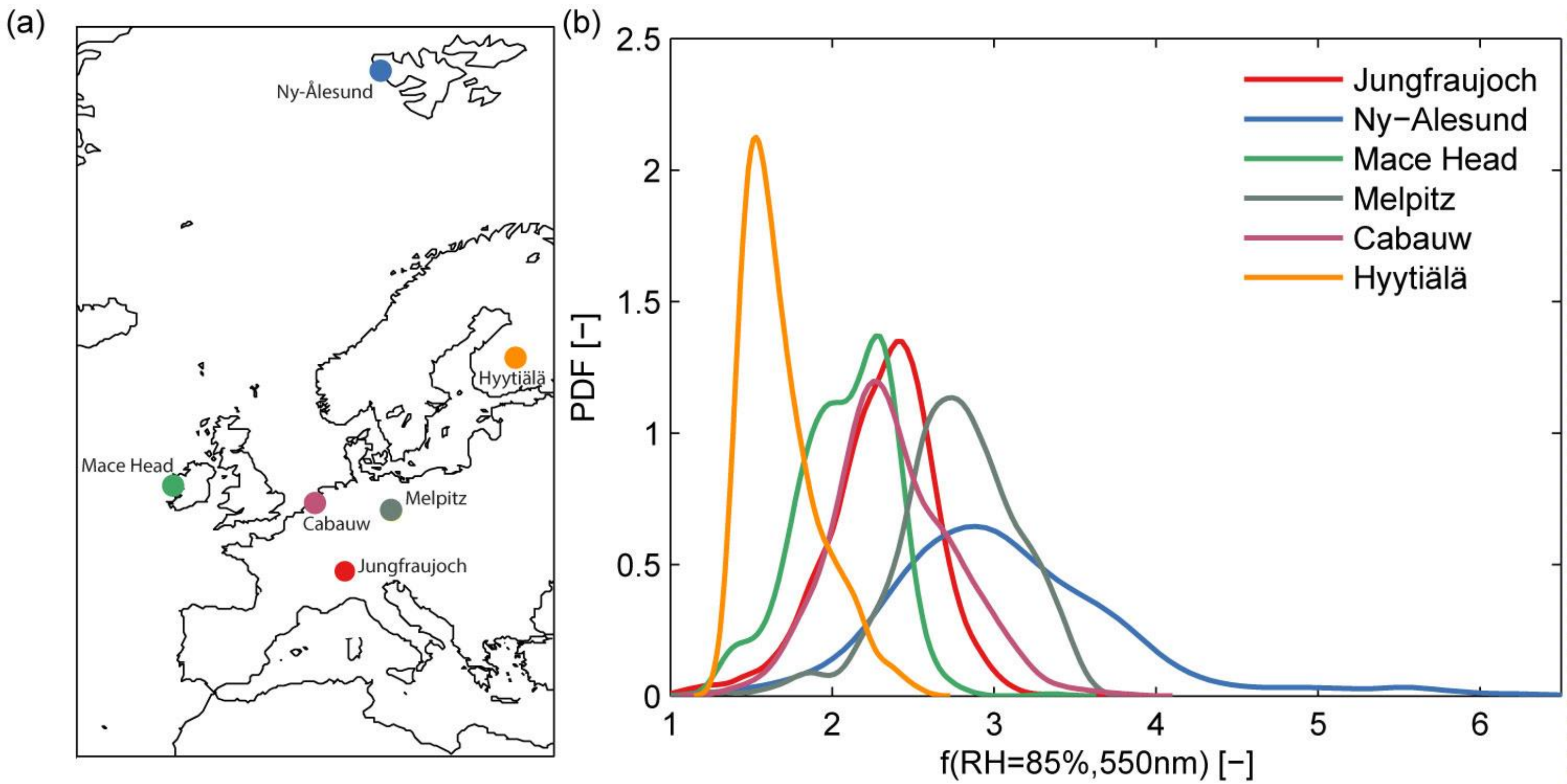
ERF

ZIEGER

Evaluation and improvement of the parameterization of aerosol hygroscopicity in global climate models using in-situ surface measurements.

Paul Zieger, Gloria Titos and Betsy Andrews

Scattering enhancement *f*(RH) = wet / dry aerosol light scattering coefficient



Evaluation and improvement of the parameterization of aerosol hygroscopicity in global climate models using in-situ surface measurements.

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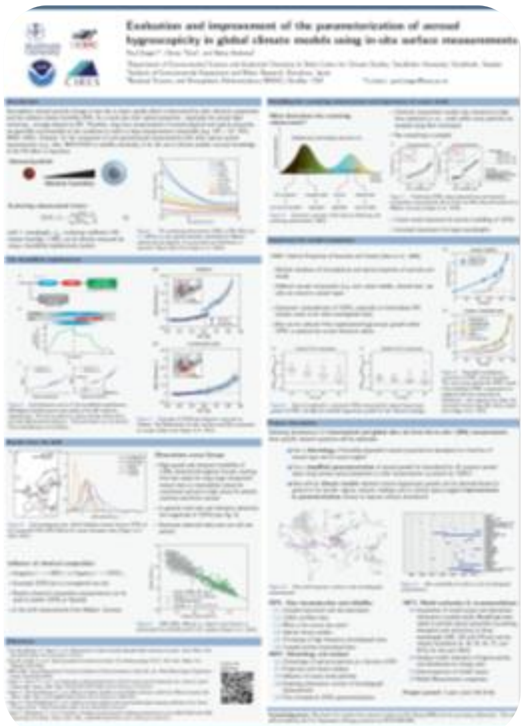
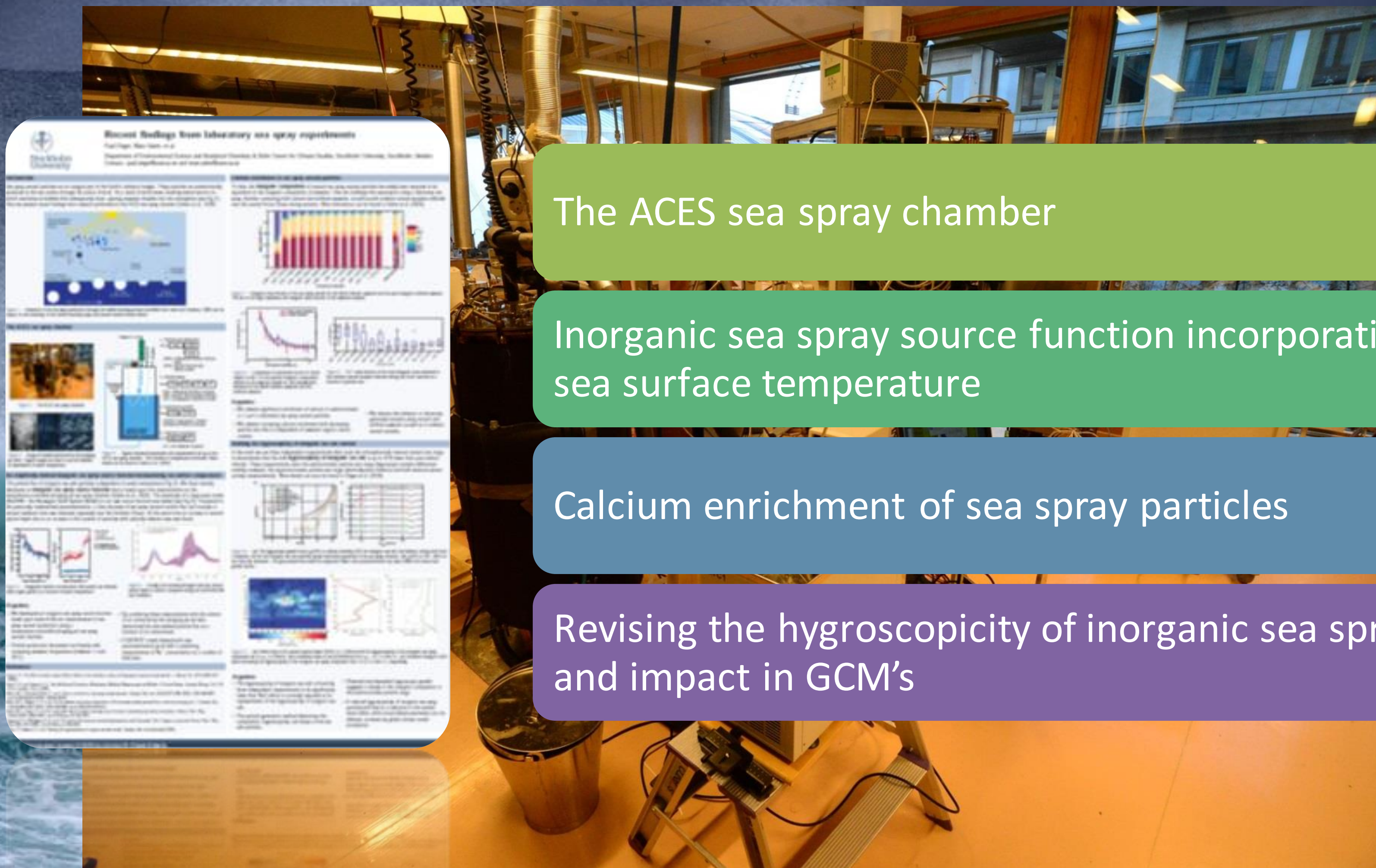


- Measurement technique and results from the field
- Modelling the scattering enhancement and importance of coarse mode
- Importance for model comparison and improvement
- Start of project to develop harmonized and global dataset used for (AeroCom) model evaluation

ZIEGER

Recent findings from laboratory sea spray experiments.

Paul Zieger, Matt Salter et al.



- The ACES sea spray chamber
- Inorganic sea spray source function incorporating sea surface temperature
- Calcium enrichment of sea spray particles
- Revising the hygroscopicity of inorganic sea spray and impact in GCM’s

Source: colostate.edu